INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

M.TECH SYLLABUS for *Specialization*: CHEMICAL ENGINEERING

BRANCH: CHEMICAL ENGINEERING (2018-19 Admission Batch)

First Semester				Second Semester			
Theory				**Theory**			
Course Code	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**	**Course Code**	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**
	Programme Core-1	3-0-0	3		**Programme Core-3**	3-0-0	3
CHC101	Advanced Mass Transfer			CHC201	Advanced Heat Transfer		
	Programme Core-2	3-0-0	3		**Programme Core-4**	3-0-0	3
CHC102	Advanced Fluid Dynamics			CHC202	Application of Mathematical and statistical methods in Chemical Engineering		
	Programme Elective-1 (Any One)	3-0-0	3		**Programme Elective-3 (Any One)**	3-0-0	3
CHE101	Advanced Process Control			CHE201	Advanced Reaction Engineering		
CHE102	Chemical Engineering Economics and Plant Design			CHE202	Fluidization Engineering		
CHE103	Industrial Pollution Control			CHE203	Pinch Technology		
	Programme Elective-2 (Any One)	3-0-0	3		**Programme Elective-4 (Any One)**	3-0-0	3
CHE104	Bioprocess Engineering			CHE204	Petroleum Refinery Engineering		
CHE105	Polymer Technology			CHE205	Advanced Separation Technology		
GHM101	Research Methodology & Intellectual Property Rights	2-0-0	2	CHE206	Computational Fluid Dynamics		
	Audit Course-1 (Any One from the list of Audit Courses)	2-0-0	0		**Audit Course-2 (Any One from the list of Audit Courses)**	2-0-0	0
	Total (Theory)	**16**	**14**		**Total (Theory)**	**14**	**12**
	Practical/ Sessional				**Practical/ Sessional**		
	Lab-1	0-0-4	2		**Lab-3**	0-0-4	2
CHC103	Experimental Lab-1			CHC203	Experimental Lab-2		
	Lab-2	0-0-4	2		**Lab-4**	0-0-4	2
CHJ101	Seminar			CHC204	Experiments related to research activity and comprehensive viva		
				CHJ201	**Mini Project with Seminar**	0-0-4	2
Total (Practical/ Sessional)		**8**	**4**	**Total (Practical/ Sessional)**		**12**	**6**
TOTAL		**24**	**18**	**TOTAL**		**26**	**18**
TOTAL SEMESTER CREDITS: 18				TOTAL SEMESTER CREDITS: 18			
TOTAL CUMULATIVE CREDITS: 18				TOTAL CUMULATIVE CREDITS: 36			

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

M.TECH SYLLABUS for *Specialization*: CHEMICAL ENGINEERING

BRANCH: CHEMICAL ENGINEERING (2018-19 Admission Batch)

Third Semester				Fourth Semester			
Theory				**Theory**			
Course Code	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**	**Course Code**	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**
	Programme Elective-5 (Any One)	3-0-0	3				
	Open Elective (Any One) Business Analytics Industrial Safety Operations Research Cost Management of Engineering Projects Composite Materials Waste to Energy Internet of Things Soft Computing Project Engineering & Management Start-up & Entrepreneurship Development	3-0-0	3				
	Total (Theory)	**6**	**6**		**Total (Theory)**	**0**	**0**
	Practical/ Sessional				**Practical/ Sessional**		
CHJ301	Dissertation Phase-I	0-0-20	10	CHJ401	Dissertation Phase-II	0-0-32	16
Total (Practical/ Sessional)		**20**	**10**	**Total (Practical/ Sessional)**		**32**	**16**
TOTAL		**26**	**16**	**TOTAL**		**32**	**16**
TOTAL SEMESTER CREDITS: 16				TOTAL SEMESTER CREDITS: 16			
TOTAL CUMULATIVE CREDITS: 52				TOTAL CUMULATIVE CREDITS: 68			

List of Audit courses

1	AHM101	English for Research Paper Writing
2	ACE101	Disaster Management
3	AHM102	Sanskrit for Technical Knowledge
4	AHM103	Value Education
5	AHM104	Constitution of India
6	AHM105	Pedagogy Studies
7	AHM106	Stress Management by Yoga
8	AHM107	Personality Development through Life Enlightenment Skills

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

M.TECH SYLLABUS for *Specialization*: CHEMICAL ENGINEERING

BRANCH: CHEMICAL ENGINEERING (2018-19 Admission Batch)

1st Semester

CHC101	ADVANCED MASS TRANSFER	3L-0T-0P	3 Credits

Objective of the course: To study the molecular mass transfer with eddy diffusion, mass transfer in solids, the thermodynamic concepts of phase equilibrium with isothermal flash calculation, distillation of multi component system and calculation of number of plates, concept of crystal formation and growth kinetics and calculation.

MODULE-I (Mass Transfer and Diffusion) (11 Hours)

Fick's law of diffusion; diffusion solids, One-dimensional, Models for mass transfer at a fluid-fluid interface: Film theory; Penetration theory; surface-renewal theory.

MODULE-II (Phase Equilibrium) (10 Hours)

Thermodynamic basics of phase equilibrium Phase rule, Non ideal vapor-liquid equilibrium, Activity co-efficient, K-Factor, Vapor-liquid equilibrium calculations for non-ideal systems, Isothermal flash calculations.

MODULE-III (Multicomponent Distillation) (11 Hours)

Basic schemes of operation, Equilibrium data, Feed and product compositions, Key components, Relative volatility of Multicomponent systems, Minimum reflux ratio calculation by Colburn's and Underwood's method. Total number of plates calculation by Lewis-Matheson method. Total reflux and the number of plates: Fenske equation, Smith-Brinkley method, Gilliland's method. Azeotropic distillation, extractive distillation, Molecular distillation, solvent selectivity.

MODULE-IV (Crystallization) (10 Hours)

Crystal growth kinetics, Super saturation, Thermodynamics considerations, Material and enthalpy balance calculations, Equipments for continuous and batch crystallization.

Text Books:

1. Mass Transfer Operations by Robert E Treybal
2. Separation Process Principles by Seader, Henley & Roper.
3. Principles of Mass Transfer by Binay K Dutta.
4. Unit operations of chemical Engineering, Vol-II, by P. Chattopadhyay
5. Chemical Engineering Volume 1: Fluid Flow, Heat Transfer and Mass Transfer by Coulson and Richardson.

Course Outcomes: At the end of the course student should learn

1. Mass transfer with external force
2. Non-ideal phase equilibrium
3. Calculation in multi component system
4. Crystal Formation, growth kinetics

CHC102	ADVANCED FLUID DYNAMICS	3L-0T-0P	3 Credits

Objective of the Course:

This course aims to derive the partial differential equations governing the conservation of mass, momentum, and energy of an incompressible Newtonian fluid, obtain dimensionless forms of the governing equations, and from these extract the dimensionless parameters that determine the flow field, present some exact solutions to the Navier-Stokes equations, derive the boundary layer equations and show how to obtain exact and approximate integral solutions.

Pre-Requisites: Basic knowledge of Mathematics and Fluid Mechanics

MODULE-I **(10 Hours)**

Brief recapitulation of some preliminary concepts of Fluid Mechanics: Equivalent momentum theorem, Equation of change of ideal flow, Continuity equation in Cartesian, cylindrical, and spherical coordinates, Euler's equation of motion.

MODULE-II **(10 Hours)**

Principle of Rotational and Irotational flow, Laplace equation, Stream function, Velocity potential, Cauchy-Rieman equation. Dynamic Viscous flow: Derivation of Navier-stokes equation, Application to a flow cases viz. two dimensional flow between two parallel plates, laminar flow in round pipe(Hagen Poiseuille flow), Creep flow and Couette flow, Expression for total drag.

MODULE-III **(11 Hours)**

Turbulent flow: Transition to turbulence, Prandtl's mixing length, Turbulence model. Boundary layer: Boundary layer on immersed bodies, Two dimensional boundary layer equation, Laminar boundary layer on flat plate (Blasius' exact solution), Von-karman Integral momentum equation.

MODULE-IV **(11 Hours)**

Stability analysis of laminar flow, Orr-Sommerfield solution, Transition and Turbulence, Detailed modeling of turbulent flow. Laminar and Turbulent flow of non-Newtonian fluid. Rheological characteristics, Consistency measurement, Viscometric flow, Pipe and Annular flow.

Book for Reference:

1. Fluid Mechanics: by Pijush K. Kundu, Ira M. Cohen, David R Dowling, Academic Press
2. Introduction to Fluid Mechanics and Fluid Machines: by S. K. Som, Gautam Biswas and Suman

Chakraborty, McGraw-Hill Education
3. Fluid Mechanics: by F. M White, McGraw-Hill Education
4. Introduction to Fluid Mechanics: by R. Fox and A. MacDonald, John Wiley and Sons
5. Transport Phenomena: by R. B. Bird, W. E. Stewart and E. N. Lightfoot, John Wiley and Sons
6. Vector Tensor and Basic equations of Fluid Mechanics: by R. Aris, Dover Books
7. Fluid Dynamics and Heat Transfer by J. G. Knudsen and D. L. Katz, McGraw-Hill Education

Course Outcomes:

At the end of the course, the students should be able to

1. Review and understand the continuity, momentum and energy equations for viscous, incompressible fluids.
2. Understand vorticity and circulation concepts and theorems.
3. Understand and utilize approximate solutions of the Navier-Stokes equation.
4. Have a fundamental understanding of analytic and numerical methods used to solve fluid dynamics problems.
5. Understand the usage of tables and charts to determine properties for problem solutions.
6. Develop the skill to develop models of real processes and systems and draw conclusions.

CHE101	ADVANCED PROCESS CONTROL	3L-0T-0P	3 Credits

Objective of the course: To study the dynamic behaviour of different physical systems and to know the needs of the control system in any chemical process industries.

MODULE-I **(10 Hours)**

Preliminary concepts of process control, response of first order, second order system, controller transfer function, block diagram of chemical reactor, modeling of few complicated system, state space and transfer function matrix model.

MODULE-II **(10 Hours)**

Stability of the control system, stability criterion of transfer function matrix models, Frequency response, Control system design by frequency response.

MODULE-III **(11 Hours)**

Development of empirical model from process data, identifying discrete time models from the experimental data, Study of cascade control system, Dead time compensation, internal model control, controller tuning and process identification, control valves, design of feed forward and ratio control.

MODULE-IV **(11 Hours)**

Digital sampling, filtering and control: sampling period, analog and digital filters, Z-transform.

Design of digital controller: multi loop control, calculation of extent of interaction and pairing of controlled and manipulated variables.

Study of model predictive control (MPC), concepts of statistical process control.

Text Books

1. Seborg, D. E., Edgar, T. F., Mellichamp, D. A. and Doyle, F. J., *Process Dynamics and Control*, John Willey & Sons.
2. Ogunnaike, B. A. and Ray, W. H., *Process Dynamics, Modelling and Control*, Oxford University Press.
3. Bequete, B. W., *Process Control: Modelling, analysis and Simulation*, PHI.
4. Coughanowr, D. R., *Process Systems Analysis and Control*, McGraw-Hill, 1991.

Course Outcomes:

At the end of the course, the student should be able to

1. Demonstrate familiarity with process control terminology and understand the following control strategies: feed-back control, feed-forward control, and cascade control; as well as the difference between linear and nonlinear systems.
2. Predict the closed-loop behaviour and evaluate the stability of simple control loops.
3. Use tuning relationships for PID controllers.

CHE102	CHEMICAL ENGINEERING ECONOMICS AND PLANT DESIGN	3L-0T-0P	3 Credits

Objective of the course: - To conduct theoretically-based, problem-solving investigations in anticipation of, rather than in response to, issues and concerns in the areas of: Plant design and its economics.

MODULE-I **(14 Hours)**

Process design aspects, Selection of process, factors affecting process selection, types of flow diagrams. Standard versus special equipment, materials of construction, selection criteria etc. Design of pressure vessels under internal pressure, Construction features, Pressure vessel code, Design of shell, various types of heads, nozzles, flanges for pressure vessel, Design and construction features of thick-walled pressure vessels, Various types of jackets and coils for reactors, Auxiliary process vessels.

MODULE-II **(14 Hours)**

Design of heat exchangers, Types of heat exchangers, Selection criteria, Design of heat exchangers- shell, tube, baffles, closures, channels, tube sheets etc. Design of distillation and absorption columns, Basic features of tall vertical equipments/ towers, Towers/Column Internal, Design of tower shell andInternals, supports etc.

MODULE-III **(14 Hours)**

Plant location and layout, Factors affecting plant location, use of scale models. Cost estimation, Factors involved in project cost estimation, total fixed & working capital, types & methods of Estimation of total

capital investment, estimation of total product cost, factors involved. Depreciation, Types and methods of determination, evaluation, Profitability, Optimum design.

BOOKS RECOMMENDED:

1. Peters M.S., Timmerhaus, K.D., "Plant Design and Economics for Chemical Engineers", 4th Ed., McGraw-Hill, Singapore, 1991.
2. Vilbrant F.C., Dryden, C.E., "Chemical Engineering and Plant Design", 4thEd., McGraw-Hill, New York,1959.
3. Sinnott, R. K., Coulson, J. M., & Richardson, J. F. (2005). *Coulson & Richardson's chemical engineering: Vol. 6*. Oxford: Elsevier Butterworth-Heinemann.
4. Davis, G.S, "Chemical Engineering Economics and Decision Analysis", CENDC, I.I.T., Madras, 1981.
5. Holland, F.A., Watson, F.A and Wilkinson, J.K., "Introduction to Process Economics", Wiley, New York, 1974.

Course Outcomes:

At the end of the course, the students should be able to

1. Designing and using commercial media for Industrial Process.
2. Understanding the design of specific equipment's used in a process industry.
3. Know the process of establishing a plant location and its layout.

CHE103	INDUSTRIAL POLLUTION CONTROL	3L-0T-0P	3 Credits

Objective of the course: - To study the various aspects of industrial pollution control, design aspects of pollution control equipments and control measures of different types of pollutants.

MODULE-I **(10 Hours)**

Definition and classification of pollutants, Environmental protection Acts, Introduction and need for Environmental Impact Assessment, Methodologies, Environmental Management Plan, Environmental standards, Hazardous Waste, e-waste.

MODULE-II **(11 Hours)**

Water pollution: Sources, Types of water pollutants, Water pollution laws and standards, Sampling, Determination of organic matter (DO, BOD, COD, TOC), Determination of Inorganic substances, Physical Characteristics, Water quality standards, Wastewater treatment - Physical treatment, Chemical treatment, Biological treatment.

MODULE-III **(11 Hours)**

Air pollution: Introduction, Sources, Effects on living beings, vegetation and non-living things, Air pollution Laws and Minimum national standards, Meteorological aspects of air pollutant dispersion (lapse rate, stability, plume rise), Air Pollution sampling, modeling and measurement, air pollution control methods and design of equipment (Gravity settling chambers, cyclones, Fabric filters, electrostatic precipitators, Venturi scrubber).

MODULE-IV **(10 Hours)**

Noise pollution: Definition, causes and effects, control measures. Solid waste: classification, collection and disposal management.

Text and Reference Books:

1. Wathern Peter, 1988, Environmental Impact Assessment – Theory and practice, Unwin Hyman Ltd.
2. Rao, C. S., 1991, Environmental Pollution Control Engineering, Wiley Eastern Limited, New Delhi.
3. M.N. Rao and H.V.N. Rao, "Air Pollution", Tata McGraw Hill, New Delhi, 1993.
4. Tchobanoglous, G., Burton, F. L., Waste Water Engineering (Metcalf and Eddy), Tata McGraw –Hill Publishing Company Limited, New Delhi.
5. Kiely, G., 2006, Environmental Engineering, Tata McGraw – Hill Publishing Company Limited, New Delhi.

Course Outcomes:

At the end of the course, the students should be able to

1. Know about environmental impact assessment.
2. Understand the sampling methods of different types of pollutants.
3. Design few pollution control equipment.

CHE104	BIOPROCESS ENGINEERING	3L-0T-0P	3 Credits

Objective of the course:-To conduct theoretically-based, problem-solving investigations in anticipation of, rather than in response to, issues and concerns in the areas of: Bioprocess engineering for adding value to Biotechnology.

MODULE I **(14 Hours)**

Introduction: Biochemical Engineering, Biological Process. Fermentation Processes General requirements of fermentation processes- An overview of aerobic and anaerobic fermentation processes and their application in industry - Medium requirements for fermentation processes .media Design and usage of commercial media for industrial fermentation. Sterilization: Thermal death kinetics of microorganisms - Batch and Continuous Heat-Sterilization of liquid Media- Filter Sterilization of Liquid Media and Air.

MODULE II **(14 Hours)**

Enzyme Technology, Microbial metabolism enzymes: Classification and properties, Applied enzyme catalysis - Kinetics of enzyme catalytic reactions, Metabolic pathways, Protein synthesis in cells. ; Bioreactor design &operations, Selection, scale up, operation of bioreactors, Mass transfer in heterogeneous biochemical reaction systems; Oxygen transfer in submerged fermentation processes; oxygen uptake rates and determination of oxygen transfer rates and coefficients; role of aeration and agitation in oxygen transfer, Heat

transfer processes in biological systems.

MODULE III **(14 Hours)**

Introduction to instrumentation and process control in bioprocesses: measurement of physical and chemical parameters in bioreactors, Monitoring and control of dissolved oxygen, pH, impeller speed and temperature in a stirred tank fermenter. Bioprocess patenting and economics.

Text and Reference Books:

1. M.L. Shuler and F. Kargi, "Bio-process Engineering", 2nd Edition, Prentice Hall of India, New Delhi. 2002.
2. Rajiv Dutta, "Fundamentals of Biochemical Engineering", 1st Edition, Springer, 2008.
3. J.E. Bailey and D.F. Ollis, "Biochemical Engineering Fundamentals", 2nd Edn, McGraw Hill, Publishing Co.New York, 1986.
4. P.Stanbury, A. Whitakar and S.J.Hall, "Principles of Fermentation Technology" 2nd Edn., ElsevierPergamon Press, 1995.

Course Outcomes:

At the end of the course, the students should be able to

1. Designing and using commercial media for industrial fermentation
2. Understanding the Enzyme Technology Selection and operation of bioreactors.
3. Know the process control in Bioprocess Engineering.

CHE105	POLYMER TECHNOLOGY	3L-0T-0P	3 Credits

Objective of the course: - To study the various aspect pertaining to Polymer materials, manufacturing of virgin polymers and to process polymer material in a mould.

MODULE-I **(14 Hours)**

Introduction & Basic Concepts, Polymer based industries and feed stocks. Classification of Polymers. State of polymer, Chain polymerization: Mechanism and kinetics; copolymerization. Condensation polymerization, coordination polymerization, Techniques of polymerization. Properties of plastics and macromolecular structure. Mechanical properties: Elasticity, visco elasticity, factors affecting mechanical behaviour etc. Polymer degradation. Molecular weight of polymers and its determination by viscometry, light-scattering, and osmotic pressure methods.

MODULE-II **(14 Hours)**

Plastics–Materials & some typical manufacturing process, (poly olefins, PVC, PS, PMMA, Epoxy resins etc.). Biodegradable Polymers. Testing of Polymers.Composites:Components and their role, Compatibility and property behavior, Important composites and their applications, Specialty materials.

MODULE-III **(14 Hours)**

Polymer additives, Processing of plastics and rubbers. Casting and moulding of plastics, equipment's design of moulds. Plastic materials and elastomers as materials of construction in chemical equipment's.

Text and Reference Books:

1. Textbook of Polymer Science by F W Billmeyer, Wiley.
2. Polymer Science and Technology, 3rd ed. by J R Fried, PHI.
3. Principles of Polymerization, 4th ed. by G Odian, Wiley.
4. Polymer Science, 2nd ed. by VR Gowarikar, JSreedhar, and NV Viswanathan, New Age.
5. Introduction to Polymer Science and Technology by N B Singh and S SDas, New Age.

Course Outcomes:

At the end of the course, the students should be able to

1. Classify the Polymers, Polymerization mechanism and techniques of synthesizing.
2. Understanding the different properties of polymers and determining the molecular weights.
3. Know the manufacturing of polymers and how to prepare moulded article.

GHM101	Research Methodology & Intellectual Property Rights	2-0-0	Credits 2

MODULE-I **(06 Hours)**

Meaning of research problem, Sources of research problem, Criteria characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.

Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

MODULE-II **(04 Hours)**

Effective literature studies approaches, analysis,

Plagiarism, Research ethics.

MODULE-III **(04 Hours)**

Effective technical writing, how to write report, Paper.

Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

MODULE-IV **(06 Hours)**

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

MODULE-V **(04 Hours)**

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

MODULE-VI **(04 Hours)**

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Text/Reference Books:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science& engineering students'".
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.
5. Mayall, "Industrial Design", McGraw Hill, 1992.
6. Niebel, "Product Design", McGraw Hill, 1974.
7. Asimov, "Introduction to Design", Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016.
9. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

Course Outcomes: At the end of the course, students will be able to

1. Understand research problem formulation.
2. Analyze research related information
3. Follow research ethics
4. Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property.

   Right to be promoted among students in general & engineering in particular.
6. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Audit Courses

AHM101	English for Research Paper Writing	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Understand that how to improve your writing skills and level of readability
2. Learn about what to write in each section
3. Understand the skills needed when writing a Title

   Ensure the good quality of paper at very first-time submission

MODULE-I **(4 Hours)**

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

MODULE-II **(4 Hours)**

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction.

MODULE-III **(4 Hours)**

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

MODULE-IV **(4 Hours)**

key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed whenwriting a Review of the Literature.

MODULE-V **(4 Hours)**

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions.

MODULE-VI **(4 Hours)**

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

Suggested Studies:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book.

4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

ACE101	Disaster Management	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

MODULE-I **(4 Hours)**

Introduction

Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

MODULE-II **(4 Hours)**

Repercussions of Disasters and Hazards:

Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem.

Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

MODULE-III **(4 Hours)**

Disaster Prone Areas In India

Study of Seismic Zones; Areas Prone To Floods And Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics

MODULE-IV **(4 Hours)**

Disaster Preparedness and Management

Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data From Meteorological and Other Agencies, Media Reports: Governmental and

Community Preparedness.

MODULE-V **(4 Hours)**

Risk Assessment

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategiesfor Survival.

MODULE-VI **(4 Hours)**

Disaster Mitigation

Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation In India.

Text / Reference Books:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies, NewRoyal book Company.
2. Sahni, Pardeep Et. Al. (Eds.)," Disaster Mitigation Experiences and Reflections", Prentice Hall OfIndia, New Delhi.
3. Goel S. L., Disaster Administration And Management Text And Case Studies", Deep &Deep Publication Pvt. Ltd., New Delhi.

AHM102	Sanskrit for Technical Knowledge	2-0-0	Credits 0

Course Objectives:

1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. Learning of Sanskrit to improve brain functioning
3. Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power
4. The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature

MODULE-I **(8 Hours)**

- Alphabets in Sanskrit
- Past/Present/Future Tense
- Simple Sentences

MODULE-II **(8 Hours)**

- Order
- Introduction of roots
- Technical information about Sanskrit Literature

MODULE-III **(8 Hours)**

- Technical concepts of Engineering-Electrical, Mechanical,Architecture, Mathematics

Suggested reading:

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

Course Output: Students will be able to

1. Understanding basic Sanskrit language
2. Ancient Sanskrit literature about science & technology can be understood
3. Being a logical language will help to develop logic in students

AHM103	Value Education	2-0-0	Credits 0

Course Objectives: Students will be able to

1. Understand value of education and self- development
2. Imbibe good values in students
3. Know about the importance of character

MODULE-I **(6 Hours)**

- Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism.
- Moral and non- moral valuation. Standards and principles.
- Value judgements

MODULE-II **(6 Hours)**

- Importance of cultivation of values.
- Sense of duty.Devotion, Self-reliance.Confidence, Concentration. Truthfulness, Cleanliness.
- Honesty, Humanity.Power of faith, National Unity.
- Patriotism.Love for nature, Discipline

MODULE-III **(6 Hours)**

- Personality and Behavior Development - Soul and Scientific attitude.
- Positive Thinking. Integrity and discipline.
- Punctuality, Love and Kindness.
- Avoid fault Thinking.
- Free from anger, Dignity of labour.
- Universal brotherhood and religious tolerance.
- True friendship.
- Happiness Vs suffering, love for truth.
- Aware of self-destructive habits.
- Association and Cooperation.
- Doing best for saving nature

MODULE-IV **(6 Hours)**

- Character and Competence –Holy books vs Blind faith.
- Self-management and Good health.
- Science of reincarnation.
- Equality, Nonviolence, Humility, Role of Women.
- All religions and same message.
- Mind your Mind, Self-control.
- Honesty, Studying effectively

Text / Reference Books

1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

Course outcomes: Students will be able to

1. Knowledge of self-development
2. Learn the importance of Human values
3. Developing the overall personality

AHM104	Constitution of India	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutionalrole and entitlement to civil and economic rights as well as the emergence of nationhood inthe early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the BolshevikRevolution in 1917 and its impact on the initial drafting of the Indian Constitution.

MODULE-I **(4 Hours)**

- **History of Making of the Indian Constitution:**

  History

  Drafting Committee, (Composition& Working)

MODULE-II **(4 Hours)**

- **Philosophy of the Indian Constitution:**

  Preamble

  Salient Features

MODULE-III **(4 Hours)**

- **Contours of Constitutional Rights & Duties:**

  Fundamental Rights

  Right to Equality

  Right to Freedom

  Right against Exploitation

  Right to Freedom of Religion

  Cultural and Educational Rights

  Right to Constitutional Remedies

  Directive Principles of State Policy

  Fundamental Duties.

MODULE-IV **(4 Hours)**

- **Organs of Governance:**

Parliament

Composition

Qualifications and Disqualifications

Powers and Functions

Executive

President

Governor

Council of Ministers

Judiciary, Appointment and Transfer of Judges, Qualifications

Powers and Functions

MODULE-V **(4 Hours)**

- **Local Administration:**

District's Administration head: Role and Importance,

Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation.

Pachayati raj: Introduction, PRI: ZilaPachayat.

Elected officials and their roles, CEO ZilaPachayat: Position and role.

Block level: Organizational Hierarchy (Different departments),

Village level: Role of Elected and Appointed officials,

Importance of grass root democracy

Model Curriculum of Engineering & Technology PG Courses [Volume -II]

MODULE-VI **(4 Hours)**

- **Election Commission:**

Election Commission: Role and Functioning.

Chief Election Commissioner and Election Commissioners.

State Election Commission: Role and Functioning.

Institute and Bodies for the welfare of SC/ST/OBC and women.

Text / Reference Books:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn. Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Outcomes: Students will be able to:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the passage of the Hindu Code Bill of 1956.

AHM105	Pedagogy Studies	2-0-0	Credit 0

Course Objectives: Students will be able to:

1. Review existing evidence on the review topic to inform programme design and policymaking undertaken by the DfID, other agencies and researchers.
2. Identify critical evidence gaps to guide the development.

MODULE-I **(4 Hours)**

- **Introduction and Methodology:**

- Aims and rationale, Policy background, Conceptual framework and terminology
- Theories of learning, Curriculum, Teacher education.
- Conceptual framework, Research questions**.**
- Overview of methodology and Searching.

MODULE-II **(2 Hours)**

- Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries.
- Curriculum, Teacher education.

MODULE-III **(4 Hours)**

- Evidence on the effectiveness of pedagogical practices

- Methodology for the in depth stage: quality assessment of included studies.
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

- Theory of change.
- Strength and nature of the body of evidence for effective pedagogical practices.
- Pedagogic theory and pedagogical approaches.
- Teachers' attitudes and beliefs and Pedagogic strategies.

MODULE-IV **(4 Hours)**

- Professional development: alignment with classroom practices and follow up support
- Peer support
- Support from the head teacher and the community.
- Curriculum and assessment
- Barriers to learning: limited resources and large class sizes

MODULE-V **(2 Hours)**

- **Research gaps and future directions**

- Research design
- Contexts
- Pedagogy
- Teacher education
- Curriculum and assessment
- Dissemination and research impact.

Text / Reference Books:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2):245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal ofCurriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International JournalEducational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

Course outcomes: Students will be able to understand:

1. What pedagogical practices are being used by teachers in formal and informal classrooms indeveloping countries?
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, andwith what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

AHM106	Stress Management by Yoga	2-0-0	Credits 0

Course Objectives:

1. To achieve overall health of body and mind
2. To overcome stress

MODULE-I **(8 Hours)**

- Definitions of Eight parts of yoga. (Ashtanga)

MODULE-II **(8 Hours)**

- Yam and Niyam.

  Do`s and Don't's in life.

  i) Ahinsa, satya, astheya, bramhacharya and aparigraha

  ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

MODULE-III **(8 Hours)**

- Asan and Pranayam

  i) Various yog poses and their benefits for mind & body

  ii) Regularization of breathing techniques and its effects-Types of pranayam

Text / Reference Books:

1. 'Yogic Asanas for Group Tarining-Part-I" :Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

Course outcomes: Students will be able to:

1. Develop healthy mind in a healthy body thus improving social health also
2. Improve efficiency

AHM107	Personality Development through Life Enlightenment Skills	2-0-0	Credits 0

Course Objectives:

1. To learn to achieve the highest goal happily
2. To become a person with stable mind, pleasing personality and determination
3. To awaken wisdom in students

MODULE-I **(8 Hours)**

Neetisatakam-Holistic development of personality

- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)
- Verses- 52,53,59 (dont's)
- Verses- 71,73,75,78 (do's)

MODULE-II **(8 Hours)**

Approach to day to day work and duties.

- Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48,
- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,
- Chapter 18-Verses 45, 46, 48.

MODULE-III **(8 Hours)**

Statements of basic knowledge.

- Shrimad Bhagwad Geeta: Chapter 2- Verses 56, 62, 68
- Chapter 12 - Verses 13, 14, 15, 16,17, 18
- Personality of Role model. Shrimad Bhagwad Geeta: Chapter 2- Verses 17, Chapter 3-Verses 36,37,42,
- Chapter 4- Verses 18, 38,39
- Chapter18 – Verses 37,38,63

Text / Reference Books:

1. "Srimad Bhagavad Gita" by Swami SwarupanandaAdvaita Ashram (PublicationDepartment), Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

Course outcomes: Students will be able to:

1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achievethe highest goal in life
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity
3. Study of Neetishatakam will help in developing versatile personality of students.

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

M.TECH SYLLABUS for *Specialization*: CHEMICAL ENGINEERING

BRANCH: CHEMICAL ENGINEERING (2018-19 Admission Batch)

2nd Semester

CHC201	ADVANCED HEAT TRANSFER	3L-0T-0P	3 Credits

Objective of the course: The objective of this course is to provide a useful foundation on heat transfer. To know various mode of heat transfer and its physical mechanism, also the study of heat exchanger and its industrial application.

Detailed Contents:

MODULE-I **(14 Hours)**

General equation of heat conduction. Application of general heat conduction equation under steady state heat conduction with internal heat generation in large slab, cylinder, sphere etc. Transient heat conduction: numerical and analytical methods for the solution of transient heat conduction problems.

MODULE-II **(14 Hours)**

Convection: Heat transfer during laminar and turbulent flow in closed conduits, empirical correlation, Heat transfer in laminar and turbulent flow over a flat plate, Heat transfer in liquid metals, Analogy between momentum and heat transfer.

Heat transfer with phase change: Boiling and condensation heat transfer. Boiling heat transfer with particular reference to Nucleate and film boiling and estimation of boiling heat transfer coefficient. Heat transfer from condensing vapors. Nusselt equation for film type condensation of vapors over vertical surfaces and inclined tubes.

MODULE-III **(14 Hours)**

Recent developments in heat exchangers: Heat Transfer Augmentation, Recent developments in the design of compact heat exchangers: Features of Plat Fin and Tube Fin heat exchangers, Construction, Heat transfer and pressure drop. Selection and design of condensers, single pass and multipass heat exchangers. Radiation heat transfer. Estimation of view factors and emissivity factors for different situation.

Book for References:

1. Som S.K., Introduction to Heat Transfer.
2. Dutta B K., Heat Transfer: Principles and Applications.
3. Holman J.P., Heat Transfer, 8th Ed.
4. Kern D. Q., Process Heat Transfer.
5. Domkundware A., A Course on Heat and Mass Transfer,
6. Rajput R.K., Heat and Mass transfer.

Course Outcomes:

At the end of the course, the student should be able to

1. Apply the basic principles of heat transfer to engineering design in an appropriate manner.
2. Apply theoretical knowledge to design heat transfer equipment used in various chemical industries.

CHC202	APPLICATION OF MATHEMATICAL AND STATISTICAL METHODS IN CHEMICAL ENGINEERING	3L-0T-0P	3 Credits

Objectives of the Course:

This course aims to design data collection plans, analyze data appropriately and interpret and draw conclusions from those analyses and to equip students with consequently requisite quantitative skills that they can employ and build on in Chemical Engineering.

MODULE-I **(14 Hours)**

Definition and scope of Statistic; Graphical representation of data; Graphical differentiation and graphical integration; Maxima and minima; Explanation of terms like errors, variance; Propagation of errors; Properties and analysis of variance; Measurement of Central Tendency like range, skewness, kurtosis.

MODULE-II **(14 Hours)**

Probability; Probability distribution; Sampling and sampling distributions; The central limit theorem; Distribution of the sample mean and the sample variance for a normal population; Chi-Square, t and F distribution; Hypothesis testing: Formulation of null and alternative hypothesis; Errors in hypothesis tests; Curve fitting; Cubic splines and approximation; Checking the adequacy of the models.

MODULE-III **(14 Hours)**

Basic principles and guidelines for design of experiments; Terminology in experimental design; Introduction to analysis of variance (ANOVA); Experiments with a Single factor; Introduction to factorial design; Response surface methods and other approaches to process optimization; Experimental design for quality improvement.

Books:

1. R. A. Johnson, 2003. " Probability and Statistics for Engineers" Prentice-Hall of India Private Limited, New Delhi
2. H. S. Mickley, T. K. Sherwood, C. E. Reed, 1990. "Applied Mathematics in Chemical Engineering" Tata McGraw Hill
3. R. E. Walpole, R. H. Myers, S. L. Myers, K. Ye, 2007. "Probability and Statistics for Engineers and Scientists" Pearson Education
4. D. C. Montgomery, 2007. " Design and Analysis of Experiments" Wiley India
5. S. S. Sastry, 1997, "Introductory methods of Numerical Analysis" Prentice-Hall of India Private

Limited, New Delhi

Course Outcomes:

At the end of the course, the students should be able to solve various problems related to statistical methods in Chemical Engineering.

CHE201	ADVANCED REACTION ENGINEERING	3L-0T-0P	3 Credits

Objective of the course: - To study the various aspect pertaining to reaction of homogeneous and heterogeneous reactions with their kinetics.

MODULE-I **(10 Hours)**

Non ideal flow in reactors, RTD of fluid in reactors, Age distribution, F curve, C curve and E curve, Intensity Function, Effects of RTD on performance of Chemical Process Equipment kinetics and design for non-catalyzed heterogeneous system Selection of a model, Determination of rate controlling step, Application to design, Application to fluidized bed,

MODULE-II **(10 Hours)**

Fluid- fluid reactions, The rate equation, Kinetic regimes for mass transfer and reaction, fast reaction, intermediate reaction, slow reaction, Slurry reaction kinetics, Application to design fluid solid non-catalytic reactions, Particles of single size, plug flow of solids, Mixture of particles of different and unchanging sizes, mixed flow of particles of a single unchanging size,

MODULE-III **(10 Hours)**

Catalytic reactors, kinetics, External and Internal Diffusional Resistances, Effects of Heat Generation/Absorption, Effectiveness Factors, Fixed Bed, Fluid Bed, Trickle bed, Slurry Reactors, Typical Catalysts used in chemical processes, Catalyst Characterizations, Catalyst Deactivation and Regeneration, Metal recovery from the Spent Catalysts ,Applications, Rise of Acidity, Modifications, Shape Selectivity

Text and Reference Books:

1. Fogler H.S., "Elements of Chemical Reaction Engineering", 4thEd., Prentice Hall, NJ, 2006.
2. Levenspiel O., "Chemical Reaction Engineering", 3rd Ed., John Wiley & Sons, Singapore, 1998.
3. Smith J. M., "Chemical Engineering Kinetics", 3rdEdition, McGraw Hill, N Y, 1981.
4. Davis M.E., Davis R.J., "Fundamentals of Chemical Reaction Engineering", McGraw-Hill, New York, 2003.

Course Outcomes:

At the end of the course, the students should be able to

1. Classify the different reactors and reactions.
2. Understanding the different homogenous and heterogeneous catalysts.
3. Know the working of ideal and non-ideal Reactors.

CHE202	FLUIDIZATION ENGINEERING	3L-0T-0P	3 Credits

Objective of the course: To study the fluidization phenomena, fluidized bed regimes and models.

MODULE-I **(11 Hours)**

Introduction to phenomenon of fluidization, fixed beds of particles, gross behaviour of fluidized beds, estimation of minimum fluidizing velocity and terminal velocity of falling particles, pressure drops; voidage, distributor plates.

Bubbles in dense beds: Davidson Model and other models for gas flow at bubbles, bubbling fluidized bed, Emulsion phase, bubble rise velocity, flow models for bubbling bed, entrainment and elutriation from fluidized beds, high velocity fluidization and pressure drop calculation.

MODULE-II **(11 Hours)**

Solid movement: mixing, segregation and staging.

Heat and mass transfer from particle-to-gas: interpretation of heat and mass transfer co-efficient from bubbling bed model.

Conversion of gas in catalytic reaction: reactor model for fine, intermediate and large particle bubbling beds, reactor model for the free board region above the fluidized bed.

Heat transfer between fluidized bed and surface, the RTD and size distribution of solids in fluidized bed.

MODULE-III **(10 Hours)**

Design for catalytic reactors; Design for non-catalytic gas-solid reactors.

MODULE-IV **(10 Hours)**

Industrial application: cracking of hydrocarbons, combustion and incineration, carbonization and gasification, calcinations, bio fluidization.

Text Books

1. Davidson, J. F., Harrison, D., 1971, *Fluidization*, Academic Press.
2. D. Kunil, D.Levenspiel, O., 1969, *Fluidization Engineering*, John Wiley.
3. Zenz, F. A., Othmer, D. F., 1960, *Fluidization and Fluid Particles Systems*, Reinhold Publishing.

Course Outcomes:

At the end of the course, the student should be able to

1. Know in-depth the understanding of fluidization
2. Know mass and energy balances in fluidization systems
3. Modelling of classical fluidization systems
4. Introduce the different miscellaneous fluidization systems

CHE203	PINCH TECHNOLOGY	3L-0T-0P	3 Credits

Objective of the course: Pinch Analysis, an algebraic and efficient optimization technique, has been applied to a wide array of problems ranging from water networks to power systems.

MODULE-I **(10 Hours)**

Process Integration: Definition of Process Integration (PI), application and techniques available for PI, onion diagram.

Pinch Technology: Introduction and basic concept, comparison with other energy auditing, role of thermodynamic laws, problem addressed by pinch technology.

MODULE-II **(11 Hours)**

Key steps of Pinch Technology: Data extraction, targeting, designing, optimization-super targeting.

Basic elements of Pinch Technology: Grid diagram, composite curve, problem table algorithm, grand composite curve.

Targeting of Heat Exchanger Network (HEN): Energy targeting, area targeting, number of units targeting, shell targeting, cost targeting.

MODULE-III **(10 Hours)**

Designing of HEN: Pinch design methods, heuristic rules, stream splitting, design of maximum energy recovery (MER), design of multi utilities and pinches, design for threshold problem, loops and paths.

MODULE-IV **(11 Hours)**

Heat integration of equipment: Heat engine, heat pump, distillation column, evaporator, drier, refrigeration systems.

Heat and Power Integration: Co-generation, steam turbine, gas turbine.

Text Books

1. Sheno, V. U., *Heat Exchanger Network Synthesis*, Gulf Publishing Co, USA, 1995.
2. Douglas, J. M., *Conceptual Design of Chemical Process*, McGraw Hill, New York, 1988.
3. Linnhoff, B., Townsend, D. W., Boland, D., Hewitt, G. F., Thomas, B. E. A., Guy, A. R. and Marsland, R. H., An User's Guide on Process Integration for the Efficient Use of Energy, Institute of Chemical Engineers, London, 1982.
4. Smith, R., Chemical Process Design, McGraw Hill, New York, 1995.

Course Outcomes:

At the end of the course, the student should be able to

1. Explain the role of thermodynamics in process design.
2. Find the minimum heating and cooling requirements for a process.
3. Identify existing non-optimal arrangements of heat exchangers.
4. Find lower cost solutions for arrangements of heat exchangers.

CHE204	PETROLEUM REFINERY ENGINEERING	3L-0T-0P	3 Credits

Objective of the course: To study the origin of crude petroleum oil and its composition analysis. To design different refinery equipment for crude oil separation. Study the principles and operations of different cracking process and its recent development in petroleum industry. Study the principles of different type of light end and heavy end processes.

MODULE-I **(10 Hours)**

Origin, formation, migration & accumulation of petroleum, Exploration, Drilling, Well completion, Recovery (primary, secondary & tertiary), Separation and transportation, indigenous and imported crudes, Availability vs. demands, Indian Refining scenario.

MODULE-II **(11 Hours)**

Crude Composition, Classification, Evaluation and Identification, Crude distillation process: atmospheric distillation unit (ADU), Vacuum distillation unit (VDU), Reactor design, Heat and mass balance calculations for atmospheric and vacuum distillation. Energy input and recovery. Refinery products, test and specifications, product blending and additives.

MODULE-III **(11 Hours)**

Catalytic cracking and Hydro cracking: Principles, recent developments, feedstock and product yields and qualities, Catalysts and operating parameters, Hydrocracking, principles, process requirements, product yield and qualities, Residcracking-implication and technology.

Catalytic reforming: Principles, developments in technology, catalyst type and their performance, operational conditions, product improvement, Extraction of aromatics. Sulfur removal, Catalyst regeneration.

MODULE-IV **(10 Hours)**

Light end processes: alkylation, isomerization and polymerization; Heavy end processes: Coking, vis-breaking, deasphalting and dewaxing; Lube oil base stock (LOBS) production.

REFERENCES:

1. Nelson, W.L "Petroleum Refinery Engineering" McGraw Hill Publishing Company Limited, 1985.
2. J.G. Speight and B. Ozum, "Petroleum Refining process", Marcel Dekker, 2002.
3. B.K. Bhaskar Rao, "Modern Petroleum refining processes" Oxford & IBH, 1984.
4. R.N. Watkins, Petroleum Refinery Distillation", Gulf Publications, 1979.
5. Hobson, G.D. "Modern petroleum refining technology, 4th edition, institute of petroleum, U.K. 1973.

Course Outcomes:

At the end of the course student should learn

1. The recent scenario of petroleum based industry

2. The composition of crude petroleum
3. To measure the properties of fuel
4. The principle of different cracking process
5. To design a refinery unit for effective separation of petroleum fractions

CHE205	ADVANCED SEPARATION TECHNOLOGY	3L-0T-0P	3 Credits

Objective of the course: - To study the various separation techniques, various aspects of separation processes and various equipments employed for separation.

MODULE-I **(10 Hours)**

General: Review of conventional processes, separation factors and its dependence on process variables, recent advances in separation techniques based on size surface properties, ionic properties and other special characteristics of substances.

MODULE-II **(11 Hours)**

Membrane separations: Types and choice of membrane, plate and frame tubular spiral wound and hollow fibre membrane reactors and their relative merits, commercial pilot plant and laboratory membrane permeators involving dialysis, reverse osmosis, nano filtration, ultra filtration, micro filtration.

MODULE-III **(11 Hours)**

Separation by adsorption Techniques and Ionic separations: Mechanism types and choice of adsorbents, normal adsorption techniques, types of equipments employed for electrophoresis, dielectrophoresis, ion exchange chromatography and electro dialysis.

MODULE-IV **(10 Hours)**

Other Techniques: Separation involving per vaporization and permeation techniques for solids liquids and gases, industrial effluent treatment by modern techniques.

Text and Reference Books:

1. W.L. Mc Cabe, J. C. Smith and P. Harriot-"Unit Operations of Chemical Engineering", Mc Graw Hill.
2. C. J. King –"Separation Processes", Tata McGraw Hill Publishing Co Ltd.
3. Kausikh Nath-"Membrane separation Processes", PHI, New Delhi.
4. H.M. Schoen, New Chemical Engg. Separation Techniques, Wiley, NY, 1972.
5. R.W.Roussel, Hand Book of Separation Process Technology, John Wiley, NY, 1987.

Course Outcomes: At the end of the course, the students should be able to

1. Know about the various separation processes.
2. Understand about the equipments employed for separation.
3. Know about the modern effluent treatment techniques.

CHE206	COMPUTATIONAL FLUID DYNAMICS	3L-0T-0P	3 Credits

Objectives of the Course:

To provide brief introduction of Computational Fluid Dynamics along with chemical engineering application specifically, analysis of fluid mechanics and heat transfer related problems.

Pre-Requisites: Basic knowledge of Fluid Mechanics, Heat Transfer, Transport Phenomena, Elementary Numerical Analysis, ODE, PDE.

MODULE-I **(11 Hours)**

Introduction to Computational Fluid Dynamics and Principles of Conservation. Classification of Partial Differential Equations and Physical Behavior. Approximate Solutions of Differential Equations.

MODULE-II **(10 Hours)**

Fundamentals of Discretization. Finite Volume Method. Discretization of Unsteady State Problems.

MODULE-III **(11 Hours)**

Important Consequences of Discretization of Time Dependent Diffusion Type Problems. Finite Volume Discretization of 2-D unsteady State Diffusion type Problems. Solution of Systems of Linear Algebraic Equations.

MODULE-IV **(10 Hours)**

Discretization of Convection-Diffusion Equations: A Finite Volume Approach. Discretization of Navier Stokes Equations. Solution to some basic problems in heat transfer and fluid flow using CFD code.

Book for Reference:

1. S. V. Patankar, Numerical Heat Transfer and Fluid Flow, McGraw-Hill.
2. T. J. Chung, Computational Fluid Dynamics, Cambridge University Press.
3. H. K. Versteeg & W. Malalasekera, An Introduction to Computational Fluid Dynamics, Longman Scientific & Technical.
4. J. H. Ferziger and M. Peric, Computational Methods for Fluid Dynamics, Springer.
5. John C. Tannehill, Dale A. Anderson and Richard H. Pletcher, Computational Fluid Mechanics and Heat Transfer, Taylor &Francis.

6. John D. Anderson Jr., Computational Fluid Dynamics, McGraw Hill Book Company.
J. Blazek, Computational Fluid Dynamics: Principles and Applications, Elsevier.

Course Outcomes: At the end of the course, the students should be able to

1. Solve PDE.
2. Use Finite Difference and Finite Volume methods in CFD modeling
3. Generate and optimize the numerical mesh
4. Simulate simple CFD models and analyze its results.

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

M.TECH SYLLABUS for *Specialization*: ENVIRONMENTAL SCIENCE & ENGINEERING

BRANCH: CIVIL ENGINEERING (2018-19 Admission Batch)

First Semester				Second Semester			
Theory				**Theory**			
Course Code	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**	**Course Code**	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**
	Programme Core-1	3-0-0	3		**Programme Core-3**	3-0-0	3
ENC101	Water Supply Engineering			ENC201	Air & Noise Pollution		
	Programme Core-2	3-0-0	3		**Programme Core-4**	3-0-0	3
ENC102	Wastewater Engineering			ENC202	Solid Waste Management		
	Programme Elective-1 (Any One)	3-0-0	3		**Programme Elective-3 (Any One)**	3-0-0	3
ENE101	Environmental Chemistry & Microbiology			ENE201	Hazardous Waste Management		
ENE102	Environmental Law, Regulation & Policy			ENE202	Industrial Pollution Control		
ENE103	Environmental Economics			ENE203	Occupational Health and Safety		
	Programme Elective-2 (Any One)	3-0-0	3		**Programme Elective-4 (Any One)**	3-0-0	3
ENE104	Advanced Water & Wastewater Treatment			ENE204	Environmental Hydraulics		
ENE105	Rural Water Supply and Sanitation			ENE205	Engineering Hydrology		
ENE106	Environmental Ecology			ENE206	Application of Remote Sensing and GIS for Environmental Studies		
GHM101	Research Methodology & Intellectual Property Rights	2-0-0	2		**Audit Course-2 (Any One from the list of Audit Courses)**	2-0-0	0
	Audit Course-1 (Any One from the list of Audit Courses)	2-0-0	0				
	Total (Theory)	**16**	**14**		**Total (Theory)**	**14**	**12**
	Practical/ Sessional				**Practical/ Sessional**		
	Lab-1	0-0-4	2		**Lab-3**	0-0-4	2
ENC103	Environmental Monitoring Lab I			ENC203	Environmental Monitoring Lab II	0-0-4	2
	Lab-2	0-0-4	2		**Lab-4**		
ENC104	Environmental Engineering Design I			ENC204	Environmental Engineering Design II		
				ENJ201	**Mini Project with Seminar**	0-0-4	2
	Total (Practical/ Sessional)	**8**	**4**		**Total (Practical/ Sessional)**	**12**	**6**
	TOTAL	**24**	**18**		**TOTAL**	**26**	**18**
TOTAL SEMESTER CREDITS: 18				TOTAL SEMESTER CREDITS: 18			
TOTAL CUMULATIVE CREDITS: 18				TOTAL CUMULATIVE CREDITS: 36			

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

M.TECH SYLLABUS for *Specialization*: ENVIRONMENTAL SCIENCE & ENGINEERING

BRANCH: CIVIL ENGINEERING (2018-19 Admission Batch)

Third Semester				Fourth Semester			
Theory				**Theory**			
Course Code	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**	**Course Code**	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**
	Programme Elective-5 (Any One)	3-0-0	3				
ENE301	Environmental Impact Assessment						
ENE302	Environmental Management						
ENE303	Numerical Methods and Modelling						
	Open Elective (Any One)	3-0-0	3				
	Business Analytics						
	Industrial Safety						
	Operations Research						
	Cost Management of Engineering Projects						
	Composite Materials						
	Waste to Energy						
	Internet of Things						
	Soft Computing						
	Project Engineering & Management						
	Start-up & Entrepreneurship Development						
	Total (Theory)	**6**	**6**		**Total (Theory)**	**0**	**0**
	Practical/ Sessional				**Practical/ Sessional**		
ENJ301	Dissertation Phase-I	0-0-20	10	ENJ401	Dissertation Phase-II	0-0-32	16
	Total (Practical/ Sessional)	**20**	**10**		**Total (Practical/ Sessional)**	**32**	**16**
	TOTAL	**26**	**16**		**TOTAL**	**32**	**16**
TOTAL SEMESTER CREDITS: 16				TOTAL SEMESTER CREDITS: 16			
TOTAL CUMULATIVE CREDITS: 52				TOTAL CUMULATIVE CREDITS: 68			

List of Audit courses

1	AHM101	English for Research Paper Writing
2	ACE101	Disaster Management
3	AHM102	Sanskrit for Technical Knowledge
4	AHM103	Value Education
5	AHM104	Constitution of India
6	AHM105	Pedagogy Studies
7	AHM106	Stress Management by Yoga
8	AHM107	Personality Development through Life Enlightenment Skills

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

M.TECH SYLLABUS for *Specialization*: ENVIRONMENTAL SCIENCE & ENGINEERING

BRANCH: CIVIL ENGINEERING (2018-19 Admission Batch)

1st Semester

ENC101	Water Supply Engineering	3-0-0	Credits 3

MODULE-I **(11 Hours)**

Quantity of Water: Per-capita water demand, design period, population growth rate, population forecasting, variation in demand. General requirement: Sources of water, aquifers, yield of open wells and tube wells.

MODULE-II **(09 Hours)**

Necessity of treatment, characteristics of water, water quality standards for various water uses, Intake structures – Different types & design criteria, pumping and transportation of water, flow through pipes, pipes in series and pipes in parallel.

MODULE-III **(12 Hours)**

Theory of sedimentation, design concepts of vertical and horizontal flow sedimentation tank. Theory of coagulation, stages of sedimentation aided with coagulation, Coagulants and coagulant aids, calculation of coagulant dose, design of various components. Mechanism of filtration, various types of filter, operational troubles in filters.

MODULE-IV **(10 Hours)**

Disinfection: different types of disinfectants, methods of disinfection, disinfecting action of chlorine, chlorine demand and residual chlorine Water Softening: Ions causing hardness, Langelier index, various methods. Dose calculations Fluoridation and de-fluoridation principles and design. Distribution system design and analysis, determination design capacity of distribution reservoirs and service reservoirs.

Text/Reference Books:

1. Water Supply Engineering, S.K. Garg, Khana Publishers..
2. Water Supply Engineering, B.C. Punmia, Laxmi Publications
3. Environmental Engineering: A Design Approach, Sincero&Sincero, PHI.
4. Water and Wastewater Technology, Hammer & Hammer, PHL
5. CPHEEO Manual, "Water Supply and Treatment", GOI Publications.

Course Outcomes: At the end of the course, students will be able to

1. Compute the quantity of water required to be supplied by a water supply system using the knowledge of water demand and population forecasting.
2. Comprehend the various stages of water supply i.e. source, collection, treatment and distribution.
3. Design water treatment units and analyse existing and design new distribution networks.
4. Understand the characteristics of water and gather knowledge on drinking water standards.

ENC102	Wastewater Engineering	3-0-0	Credits 3

MODULE-I **(11 Hours)**

Wastewaters: sources, nature and characteristics, estimation of quantities of waste water, flow rate and fluctuations, quantities of storm water, Systems of sanitation, combined and separate sewerage systems, their relative merits, Design of combined and separate systems

MODULE-II **(09 Hours)**

Sewer materials, Sewer appurtenances, Construction and maintenance of sewers and pumping of sewage, Analysis of waste water: determination of BOD, COD, Solids and volatile solids and their significance, BOD progression and its formulations.

MODULE-III **(12 Hours)**

Design of waste water treatment systems-Primary, secondary and tertiary treatments, screens, grit chambers, sedimentation tanks, chemical precipitation, Biological treatment-objectives.

MODULE-IV **(10 Hours)**

Methods and design of activated sludge and trickling filter units, Sewage sludge-its treatment, disposal and reuse, Effluent standards and its disposal.

Text/Reference Books:

1. Sewage Disposal and Air Pollution Engineering, S.K. Garg, Khana Publishers.
2. Wastewater Engineering, B.C. Punmia, Laxmi Publications
3. Wastewater, Treatment, Disposal and Reuse, Mtcalf & Eddy
4. Water and Wastewater Technology, Hammer & Hammer, PHI

Course Outcomes: At the end of the course, students will be able to

1. Compute the quantity of domestic sewage and storm drainage and design sewerage and drainage networks.
2. Determine the physical, chemical and biological characteristics of wastewater.
3. Comprehend the fundamental scientific processes underlying the design and operation of various unit operations in a wastewater treatment plant.
4. To manage, degrade and dispose of sludge produced in biological treatment units.
5. Reuse wastewater after proper treatment.

ENE101	Environmental Chemistry & Microbiology	3-0-0	Credits 3

MODULE-1 **(11 Hours)**

Symbol, valency, formula, chemical equations and their balancing, law of conservation of mass, atomic mass, molecular mass, equivalent mass, law of equivalence, modes of expressing concentration of solutions, Chemical bonding, chemical equilibrium,equilibrium constant, Lechatelier'sprinciple.

MODULE-II **(09 Hours)**

Ionic equilibrium, common ion effect, diverse ion effect, solubility, ionic product, solubility product, Acid, bases and salt, Arrhenius theory,buffer solution, alkalinity, acidity, carbonate system, chemical kinetics, order and molecularity of chemical reactions

MODULE-III **(12 Hours)**

Chemical thermodynamics: work done, internal energy, enthalpy, entropy, Gibbs free energy, specific heat, Electrochemistry: Electrochemical cell, Galvanic cell, Conductance, Equivalent conductance, specific conductance, Nernst's equation, Nuclear Chemistry: Nuclear fusion, Nuclear fission, artificial transmutation of elements. Chlorine Chemistry, Nitrogen chemistry

MODULE-IV **(10 Hours)**

Introduction, the bacteria, the fungi, the algae, protozoa and other higher forms, viruses, pathogens and disease, microbial growth and enumeration, environmental influences, control of microorganisms

Text/Reference Books:

1. Chemistry for Environmental Engineering and Science, Sawyer and Mccarty, TMH.
2. Microbiology for Environmental Scientists and Engineers, A.F. Gaudy, McGraw-Hill Int Edition.
3. Environmental Chemistry, Benerjee, PHI
4. Microbiology Demystified, Betsy, Tom, Keogh and James, TMH

Course Outcomes: At the end of the course, students will be able to

1. Gather the basic knowledge of chemistry required to be applied in various sections of Environmental Engineering.
2. Prepare standard and stock solution for performing various laboratory tests.
3. Improve welfare and sustainability of our society by applying their chemical knowledge.
4. Demonstrate that microorganisms have an indispensable role in the environment, including elemental cycles, biodegradation, etc.

ENE102	Environmental Law, Regulation & Policy	3-0-0	Credits 3

MODULE-I **(11 Hours)**

Introduction, environmental laws and policies – role of government. Environmental laws for managing Air, water, land, wastewater, solid waste.

MODULE-II **(09 Hours)**

Environmental laws for managing hazardous waste, natural resources, energy, ecology and environment.

MODULE-III **(12 Hours)**

Environmental guidelines and regulations, environmental auditing, monitoring, reporting, economics and accounting.

MODULE-IV **(10 Hours)**

Theories of corporate strategy and environmental policy; Beyond environmentalism, sustainability issues; Role of government and non-government organizations and citizens.

Text/Reference Books:

1. Environmental Law, Sengar, PHI.
2. Environmental Regulation: Law, Science, and Policy, Schroeder, Miller, Leape, Aspen Publishing.
3. Environmental Law in India, P. Leelakrishnan, Universal law Publishing Company.

Course Outcomes: At the end of the course, students will be able to

1. Have sound Knowledge of Laws, regulations and policies pertaining to environment.
2. Lead teams for environmental management.
3. Make sustainable development.

ENE103	Environmental Economics	3-0-0	Credits 3

MODULE-I **(11 Hours)**

Introduction to Environmental Economics: Scope of the problem, Interaction between economy and environment, Economist's perspectives on environmental problems. Brief idea about Quality of natural Environment and Environmental problems (Air Pollution, Water Pollution, Toxic Emission, ecosystem health).

MODULE-II **(09 Hours)**

Introduction to Environmental Policy Instruments: Choice of policy instrument, command and control instruments, taxation, tradable permits, Environmental performance bonds. Public and environmental goods, negative externality and market failure, Internalization Environmental Valuation: Contingent valuation methods, travel cost method, hedonic price method. Economics of natural resources: Natural Resources (renewable and non-renewable), Population dynamics, extraction of non-renewable resources, depletion, resource modeling.

MODULE-III **(12 Hours)**

Green and Natural resource accounting: GDP, NDP and sustainable development, Environmental accounting

Social efficiency and benefit-cost analysis: Efficiency and competitive markets, supply, demand and efficiency, benefit and cost analysis. Sustainable development and irreversibility in environmental policy: definition, economical efficiency, economic growth and environment.

MODULE-IV **(10 Hours)**

Global Environmental Issues and policies: Climate Change: Causes; possible effects; costs of mitigating greenhouse gas emissions; Carbon Trading, adaptation measures, Design of international agreements, Environmental conflict, bargaining and cooperation, Environmental issues and policies in India

Text/Reference Books:

1. Kolstad, C.D., 2000, Environmental Economics, Oxford University Press.
2. Conrad, J. M. (1999). Resource Economics. Cambridge University Press.
3. Hanley, N., Shogren, J. F., and White, B. (1997). Environmental economics in theory and practice. Oxford university press, New York.
4. M. Common and S. Stagi, (2005). Ecological Economics an introduction, Cambridge University Press.
5. R. Quentin Grafton, WiktorAdamowicz (2004). The economics of the environment and natural resources, Wiley Blackwell Publication.
6. Baumol, W.J., and E.E. Oates, 1988, The Theory of Environmental Policy, Cambridge University Press.
7. Titenberg, T., 1998, Environmental Economics and Policy, Addision-Wesley.

Course Outcomes: At the end of the course, students will be able to

1. Make cost effective design of various environmental structures.
2. Work towards cost optimization by pollution minimization.

ENE104	Advanced Water & Wastewater Treatment	3-0-0	Credits 3

MODULE-I **(11 Hours)**

Conventional water and waste water treatment methods, their capabilities and limitations, Need for advanced treatment of water and waste water.

MODULE-II **(09 Hours)**

Advanced water treatment- Iron and manganese removal, colour and odour removal, activated carbon treatment, carbonate balance for corrosion control, ion exchange, electro-dialysis, reverse osmosis and modern methods and fluoride management.

MODULE-III **(12 Hours)**

Advanced waste water treatment- Nutrient control in effluents, Nitrogen and phosphorus removal methods including biological methods, Methods for the removal of heavy metals, oil and refractory organics, Microsreening, ultra-filtration, centrifugation and other advanced physical methods- aerobic digestion, anaerobic filtration, rotating biological contractor, novel methods of aeration etc.

MODULE-IV **(10 Hours)**

Combined physico-chemical and biological processes, Activated carbon treatment, chlorination of waste water, Pure oxygen systems, Filtration for high quality effluents, Multistage treatment systems, Land treatment and other resources recovery systems

Text/Reference Books:

1. Industrial Pollution Control, W.W. Eckenfelder, McGraw Hill International Edition.
2. Advances in water and wastewater Treatment Technologies, Matsuo, Hanaki, Takizawa, Elsevier publication. .
3. Wastewater, Treatment, Disposal and Reuse, Mtcalf& Eddy

Course Outcomes: At the end of the course, students will be able to

1. Access the need for advance treatment of water and wastewater.
2. Understand the theory behind the design of advanced water and wastewater treatment methods.

ENE105	Rural Water Supply and Sanitation	3-0-0	Credits 3

MODULE-I **(11 Hours)**

Environmental sanitation in Rural and Urban Areas-concepts and importance: Environmental Sanitation,History of sanitation,Rural and Urban Sanitation, changing concept in public health and

environmental sanitation,importance of environmental sanitation,Disease &Env. Sanitation, public awareness and role of env.

MODULE-II **(09 Hours)**

Water uses drinking water, potable water for livestock, agricultural water, water quality, lake water, surface water, Ground water, Hilly area, Sources of water, collection of water, Tube well, Hand tube well, dug well, Design of deep tube well. Small scale water treatment, slow sand filter, pressure filter, package water treatment, Chlorination, water reservoir, capacity of reservoir, design of reservoir, distribution system.

MODULE-III **(12 Hours)**

Sewage disposal, cess pool, septic tank principle and design, Biogas plant, Solid waste management, storage collection, composting, vermicomposting, Block level incinerator, Epidemiology, vector transmission, diseases control, Eutriphication of pond and lakes, control.

MODULE-IV **(10 Hours)**

Low cost sanitation, farm house and Cattle shed sanitation-standard recommendation and rules, waste disposal methods, Biogas plant, indoor sanitation-Ventilation, lighting, air conditioning and thermal insulation of buildings, Sanitation of public facilities:- Markets, swimming pools, schools, roads, canteens, hotels, bus stands etc.

Text/Reference Books:

1. Water Supply Engineering, S.K. Garg, Khana Publishers
2. Municipal and Rural Sanitation - V.M Ehlers and E.W Steel, McGraw Hill Publishing Company.
3. Environmental Sanitation - V.M Ehlers and E.W Steel, McGraw Hill Publishing Company
4. Ehler and Steel- A text book of rural water supply and sanitation.
5. Manual of water supply and treatment- CPHEERO.
6. Manual of sewerage and sewage treatment - CPHEERO.
7. Salvato- Environmental Sanitation.
8. Environmental Sanitation-Baljeet S. Kapoor.

Course Outcomes: At the end of the course, students will be able to

1. Design various rural water supply and sanitation structures.
2. Know about landfilling, incineration and vermicomposting.
3. Have knowledge about packaged Treatment unit

ENE106	Environmental Ecology	3-0-0	Credits 3

MODULE-I **(11 Hours)**

Fundamentals of Ecology, Natural eco-systems and their food chains, food webs, bioenergetics, biochemical cycles and ecological succession.

MODULE-II **(09 Hours)**

Biological diversity and its importance, reduction in biological diversity by human activities, classes and general effects of pollutants, biological interactions with pollutants, lethal and sub-lethal effects.

MODULE-III **(12 Hours)**

Ecosystem responses to deoxygenation, nutrient enrichment, pesticides, hydrocarbons, metals and salts, thermal pollution, suspended solids and silt, radio nuclides and atmospheric pollutants.

MODULE-IV **(10 Hours)**

Ecotoxicology of toxic substances and assessment of the hazards, biotic indices, indicator species, ecological indicator species and chemical monitor species, Standards and criteria.

Text/Reference Books:

1. Ecology- Theories and Applications, Stiling, PHI.
2. Essentials of Ecology and Environmental Science, Rana, PHI.
3. Concepts of Ecology, Kormondy, PHI.
4. Environmental Engineering, G Keily, TMH.

Course Outcomes: At the end of the course, students will be able to

1. Comprehend about the Environment, Ecology and Ecosystem.
2. Know about biodiversity and the effect of environmental pollution on biodiversity.
3. Gather knowledge about the response of ecosystem to environmental pollution.
4. Tackle Eco toxicological effects.

ENC103	Environmental Monitoring Lab I	0-0-4	Credits 2

Syllabus: Physical, chemical and biological analysis of water and wastewater

No of Lectures: 28

Text/Reference Books:

1. Standard Methods for Examination of Water and Wastewater, APHA, USEPA

Course Outcomes: At the end of the course, students will be able to

1. Gather Knowledge about various gravimetric and titrimetric methods of environmental Chemical analysis.
2. Design their own laboratory setup and perform their research.

ENC104	Environmental Engineering Design I	0-0-4	Credits 2

Syllabus: Complete design of water treatment unit, determination of storage capacity of reservoirs, analysis and design of water distribution network

No of Lectures: 28

Text/Reference Books:

1. Water Supply Engineering, S.K. Garg, Khana Publishers.
2. Water Supply Engineering, B.C. Punmia, Laxmi Publications.
3. Environmental Engineering: A Design Approach, Sincero&Sincero, PHI.
4. Water and Wastewater Technology, Hammer & Hammer, PHL
5. CPHEEO Manual, "Water Supply and Treatment", GOI Publications.

Course Outcomes: At the end of the course, students will be able to

1. Design various water treatment Units.
2. Analyse and design water distribution network.
3. Determine the capacity of service and distribution reservoirs.

GHM101	Research Methodology & Intellectual Property Rights	2-0-0	Credits 2

MODULE-I **(06 Hours)**

Meaning of research problem, Sources of research problem, Criteria characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.

Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

MODULE-II **(04 Hours)**

Effective literature studies approaches, analysis,

Plagiarism, Research ethics.

MODULE-III **(04 Hours)**

Effective technical writing, how to write report, Paper.

Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

MODULE-IV **(06 Hours)**

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

MODULE-V **(04 Hours)**

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

MODULE-VI **(04 Hours)**

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Text/Reference Books:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science& engineering students".
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.

5. Mayall, “Industrial Design”, McGraw Hill, 1992.
6. Niebel, “Product Design”, McGraw Hill, 1974.
7. Asimov, “Introduction to Design”, Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “Intellectual Property in New Technological Age”, 2016.
9. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008

Course Outcomes: At the end of the course, students will be able to

1. Understand research problem formulation.
2. Analyze research related information
3. Follow research ethics
4. Understand that today’s world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property.

   Right to be promoted among students in general & engineering in particular.
6. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Audit Courses

AHM101	English for Research Paper Writing	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Understand that how to improve your writing skills and level of readability
2. Learn about what to write in each section
3. Understand the skills needed when writing a Title

   Ensure the good quality of paper at very first-time submission

MODULE-I **(4 Hours)**

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

MODULE-II **(4 Hours)**

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction.

MODULE-III **(4 Hours)**

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

MODULE-IV **(4 Hours)**

key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed whenwriting a Review of the Literature.

MODULE-V **(4 Hours)**

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions.

MODULE-VI **(4 Hours)**

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

Suggested Studies:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book.

4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

ACE101	Disaster Management	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

MODULE-I **(4 Hours)**

Introduction

Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

MODULE-II **(4 Hours)**

Repercussions of Disasters and Hazards:

Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem.

Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

MODULE-III **(4 Hours)**

Disaster Prone Areas In India

Study of Seismic Zones; Areas Prone To Floods And Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics

MODULE-IV **(4 Hours)**

Disaster Preparedness and Management

Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data From Meteorological and Other Agencies, Media Reports: Governmental and

Community Preparedness.

MODULE-V **(4 Hours)**

Risk Assessment

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategiesfor Survival.

MODULE-VI **(4 Hours)**

Disaster Mitigation

Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation In India.

Text / Reference Books:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies, NewRoyal book Company.
2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall OfIndia, New Delhi.
3. Goel S. L., Disaster Administration And Management Text And Case Studies" ,Deep &Deep Publication Pvt. Ltd., New Delhi.

AHM102	Sanskrit for Technical Knowledge	2-0-0	Credits 0

Course Objectives:

1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. Learning of Sanskrit to improve brain functioning
3. Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power
4. The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature

MODULE-I **(8 Hours)**

- Alphabets in Sanskrit
- Past/Present/Future Tense
- Simple Sentences

MODULE-II **(8 Hours)**

- Order
- Introduction of roots
- Technical information about Sanskrit Literature

MODULE-III **(8 Hours)**

- Technical concepts of Engineering-Electrical, Mechanical,Architecture, Mathematics

Suggested reading:

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

Course Output: Students will be able to

1. Understanding basic Sanskrit language
2. Ancient Sanskrit literature about science & technology can be understood
3. Being a logical language will help to develop logic in students

AHM103	Value Education	2-0-0	Credits 0

Course Objectives: Students will be able to

1. Understand value of education and self- development
2. Imbibe good values in students
3. Know about the importance of character

MODULE-I **(6 Hours)**

- Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism.
- Moral and non- moral valuation. Standards and principles.
- Value judgements

MODULE-II **(6 Hours)**

- Importance of cultivation of values.
- Sense of duty.Devotion, Self-reliance.Confidence, Concentration. Truthfulness, Cleanliness.
- Honesty, Humanity.Power of faith, National Unity.
- Patriotism.Love for nature, Discipline

MODULE-III **(6 Hours)**

- Personality and Behavior Development - Soul and Scientific attitude.
- Positive Thinking. Integrity and discipline.
- Punctuality, Love and Kindness.
- Avoid fault Thinking.
- Free from anger, Dignity of labour.
- Universal brotherhood and religious tolerance.
- True friendship.
- Happiness Vs suffering, love for truth.
- Aware of self-destructive habits.
- Association and Cooperation.
- Doing best for saving nature

MODULE-IV **(6 Hours)**

- Character and Competence –Holy books vs Blind faith.
- Self-management and Good health.
- Science of reincarnation.
- Equality, Nonviolence, Humility, Role of Women.
- All religions and same message.
- Mind your Mind, Self-control.
- Honesty, Studying effectively

Text / Reference Books

1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

Course outcomes: Students will be able to

1. Knowledge of self-development

2. Learn the importance of Human values
3. Developing the overall personality

AHM104	Constitution of India	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutionalrole and entitlement to civil and economic rights as well as the emergence of nationhood inthe early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the BolshevikRevolution in 1917 and its impact on the initial drafting of the Indian Constitution.

MODULE-I **(4 Hours)**

- **History of Making of the Indian Constitution:**

  History

  Drafting Committee, (Composition& Working)

MODULE-II **(4 Hours)**

- **Philosophy of the Indian Constitution:**

  Preamble

  Salient Features

MODULE-III **(4 Hours)**

- **Contours of Constitutional Rights & Duties:**

  Fundamental Rights

  Right to Equality

  Right to Freedom

  Right against Exploitation

  Right to Freedom of Religion

  Cultural and Educational Rights

  Right to Constitutional Remedies

  Directive Principles of State Policy

Fundamental Duties.

MODULE-IV **(4 Hours)**

- **Organs of Governance:**

  Parliament

  Composition

  Qualifications and Disqualifications

  Powers and Functions

  Executive

  President

  Governor

  Council of Ministers

  Judiciary, Appointment and Transfer of Judges, Qualifications

  Powers and Functions

MODULE-V **(4 Hours)**

- **Local Administration:**

  District's Administration head: Role and Importance,

  Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation.

  Pachayati raj: Introduction, PRI: ZilaPachayat.

  Elected officials and their roles, CEO ZilaPachayat: Position and role.

  Block level: Organizational Hierarchy (Different departments),

  Village level: Role of Elected and Appointed officials,

  Importance of grass root democracy

  Model Curriculum of Engineering & Technology PG Courses [Volume -II]

MODULE-VI **(4 Hours)**

- **Election Commission:**

  Election Commission: Role and Functioning.

  Chief Election Commissioner and Election Commissioners.

  State Election Commission: Role and Functioning.

  Institute and Bodies for the welfare of SC/ST/OBC and women.

Text / Reference Books:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Outcomes: Students will be able to:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the passage of the Hindu Code Bill of 1956.

AHM105	Pedagogy Studies	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Review existing evidence on the review topic to inform programme design and policymaking undertaken by the DfID, other agencies and researchers.
2. Identify critical evidence gaps to guide the development.

MODULE-I **(4 Hours)**

- **Introduction and Methodology:**
- Aims and rationale, Policy background, Conceptual framework and terminology
- Theories of learning, Curriculum, Teacher education.
- Conceptual framework, Research questions**.**
- Overview of methodology and Searching.

MODULE-II **(2 Hours)**

- Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries.
- Curriculum, Teacher education.

MODULE-III **(4 Hours)**

- Evidence on the effectiveness of pedagogical practices
- Methodology for the in depth stage: quality assessment of included studies.
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?
- Theory of change.
- Strength and nature of the body of evidence for effective pedagogical practices.
- Pedagogic theory and pedagogical approaches.
- Teachers' attitudes and beliefs and Pedagogic strategies.

MODULE-IV **(4 Hours)**

- Professional development: alignment with classroom practices and follow up support
- Peer support
- Support from the head teacher and the community.
- Curriculum and assessment
- Barriers to learning: limited resources and large class sizes

MODULE-V **(2 Hours)**

- **Research gaps and future directions**
- Research design
- Contexts
- Pedagogy
- Teacher education
- Curriculum and assessment
- Dissemination and research impact.

Text / Reference Books:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2):245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal ofCurriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic

maths and reading in Africa: Does teacher preparation count? International JournalEducational Development, 33 (3): 272–282.

5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

Course outcomes: Students will be able to understand:

1. What pedagogical practices are being used by teachers in formal and informal classrooms indeveloping countries?
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, andwith what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

AHM106	Stress Management by Yoga	2-0-0	Credits 0

Course Objectives:

1. To achieve overall health of body and mind
2. To overcome stress

MODULE-I **(8 Hours)**

- Definitions of Eight parts of yoga. (Ashtanga)

MODULE-II **(8 Hours)**

- Yam and Niyam.

  Do`s and Don't's in life.

  i) Ahinsa, satya, astheya, bramhacharya and aparigraha

  ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

MODULE-III **(8 Hours)**

- Asan and Pranayam

  i) Various yog poses and their benefits for mind & body

  ii) Regularization of breathing techniques and its effects-Types of pranayam

Text / Reference Books:

1. "Yogic Asanas for Group Tarining-Part-I" Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

Course outcomes: Students will be able to:

1. Develop healthy mind in a healthy body thus improving social health also
2. Improve efficiency

AHM107	Personality Development through Life Enlightenment Skills	2-0-0	Credits 0

Course Objectives:

1. To learn to achieve the highest goal happily
2. To become a person with stable mind, pleasing personality and determination
3. To awaken wisdom in students

MODULE-I **(8 Hours)**

Neetisatakam-Holistic development of personality

- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)
- Verses- 52,53,59 (dont's)
- Verses- 71,73,75,78 (do's)

MODULE-II **(8 Hours)**

Approach to day to day work and duties.

- Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48,
- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,
- Chapter 18-Verses 45, 46, 48.

MODULE-III **(8 Hours)**

Statements of basic knowledge.

- Shrimad Bhagwad Geeta: Chapter 2- Verses 56, 62, 68
- Chapter 12 - Verses 13, 14, 15, 16,17, 18
- Personality of Role model. Shrimad Bhagwad Geeta: Chapter 2- Verses 17, Chapter 3-Verses 36,37,42,
- Chapter 4- Verses 18, 38,39
- Chapter18 – Verses 37,38,63

Text / Reference Books:

1. "Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

Course outcomes: Students will be able to:

1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achievethe highest goal in life
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity
3. Study of Neetishatakam will help in developing versatile personality of students.

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

M.TECH SYLLABUS for *Specialization*: ENVIRONMENTAL SCIENCE & ENGINEERING

BRANCH: CIVIL ENGINEERING (2018-19 Admission Batch)

2nd Semester

ENC201	Air and Noise pollution	3-0-0	Credits 3

MODULE-I **(11 Hours)**

Air pollutants, Sources, classification, Combustion processes and pollutant emission, Effects on Health, vegetation, materials and atmosphere, Reactions of pollutants in the atmosphere and their effects-Smoke, smog and ozone layer disturbance etc.

MODULE-II **(09 Hours)**

Atmospheric diffusion of pollutants and their analysis, Transport, transformation and deposition of air contaminants on a global scale. Gaussian dispersion model and related computations, Air pollution Meteorology. Plume behaviour, Mixing height, determination of stack height.

MODULE-III **(11 Hours)**

Air sampling and pollutant measurement methods, principles and instruments, ambient air quality and emission standards, control principles, Removal of gaseous pollutants by adsorption, absorption, reaction and other methods. Particulate emission control, settling chambers, cyclone separation, Wet collectors, fabric filters, electrostatic precipitators and other removal methods.

MODULE-IV **(11 Hours)**

Noise Pollution – Definition, Sources, Effects, Mechanisms, SPL, Decibel concepts, Level of pollution, Estimation of equivalent SPl, LD_{eq} Control of noise pollution, Source control, devices, High way and industrial noise estimation, Noise level monitoring techniques

Text/Reference Books:

1. Sewage Disposal and Air Pollution Engineering, S.K. Garg, Khana Publishers.
2. Air pollution M.N Rao& H.V.N. Rao. , TMH
3. Environmental Engineering, Peivy and Rowe.
4. Air pollution Control Engineering, Noel De Nevers, McgrawhillInt Edition.

Course Outcomes: At the end of the course, students will be able to

1. Understand the classification, sources and effects of air pollutants.
2. Understand Regional, global pollution transport mechanisms.
3. Develop pollution control devices: Cyclone, electrostatic precipitator, packed towers, gravitational separator, bag house, scrubbers.
4. Gather knowledge on sources, characteristics and effects of noise pollution.

ENC202	Solid Waste Management	3-0-0	Credits 3

MODULE-I **(11 Hours)**

Solid wastes-Sources, nature and characteristics, Quantities and qualities, Rates of generation and factors affecting them. Potential of diseases, nuisances and other problems due to solid wastes.

MODULE-II **(09 Hours)**

Changing nature of solid wastes and its impact on solid waste management, Solid wastes management-Generation, on-site storage, collection, separation, processing and disposal On-site storage methods-containers, their type, size and location.

MODULE-III **(11 Hours)**

Collection systems-Vehicles, routing, route balancing and transfer stations, Processing methods, recovery and reuse of materials and energy.

MODULE-IV **(11 Hours)**

Disposal methods such as sanitary landfill biological digestion etc. Industrial and Hazardous solid waste management, Urban solid waste management and its modeling.

Course Outcomes: At the end of the course, students will be able to

1. Get a comprehensive overview of source, classification, characterization of solid, waste.
2. Know about collection and transportation of solid waste.
3. Design transfer stations, sanitary landfills, Composting plants and incinerators.
4. Expertise on recycle, recover and reuse of solid waste.
5. Take up solid waste management projects

ENE201	Hazardous Waste Management	3-0-0	Credits 3

MODULE-I **(11 Hours)**

Sources of hazardous waste: types and sources hazardous wastes - need for hazardous waste management - elements of integrated hazardous waste management and roles of stakeholders and NGOs- salient features of Indian legislations on management and handling of hazardous wastes, biomedical wastes, lead acid batteries, e-waste.

MODULE-II **(9 Hours)**

Characterization of hazardous waste :hazardous waste generation rates and variation - composition, physical, chemical and biological properties of hazardous wastes - hazardous characteristics – tclp tests - waste sampling and characterization plan - source reduction of wastes -recycling and reuse.

MODULE-III **(11 Hours)**

Handling of hazardous waste: handling and segregation of wastes at source - storage and collection of hazardous. Wastes -need for transfer and transport - transfer stations optimizing waste. Allocation - compatibility, storage, labelling and handling of hazardous wastes.

MODULE-IV **(11 Hours)**

Processing of hazardous waste: objectives of waste processing - material separation and processing

Technologies- biological and chemical conversion technologies - thermal conversion technologies and energy recovery - incineration - solidification and stabilization of hazardous wastes – treatment of biomedical wastes and e-waste. Disposal of hazardous waste: waste disposal options - disposal in landfills - landfill classification-construction and operation of secured landfills -bioreactors – ocean dumping - land disposal – soil remediation.

Books for reference:

1. Hazardous Waste Management: Charles A. Wentz, TMH
2. Introduction to Environmental Engineering, Master, TMH.
3. Environmental Engineering, G Keily, TMH.
4. Principles of Environmental Engineering and Science, Davis, Masten, TMH.

Course Outcomes: At the end of the course, students will be able to

1. Get a comprehensive overview of source, classification, characterization of hazardous waste.
2. Know about collection and transportation of hazardous waste.
3. Design transfer stations, sanitary landfills, Composting plants and incinerators for hazardous waste
4. Take up hazardous waste management projects.

ENE202	Industrial Pollution Control	3-0-0	Credits 3

MODULE-I **(11 Hours)**

Industrial waters-Sources, nature and characteristics, quantity and quality of industrial wastes and their impact on the environment, Industrial waste survey, estimating organic content. Industrial Waste survey - Process flow charts, condition of waste stream. Sampling – Grab, Composite and integrated samples. Continuous monitoring – pH, Conductivity, Biomonitoring. Pre and primary treatment- equalization, neutralization,

MODULE-II **(9 Hours)**

sedimentation, oil separation, flotation, Coagulation and precipitation, heavy metal removal, principles of biological oxidation, biological wastewater treatment processes- lagoons and stabilization basins, aerated lagoons, activated sludge process, Trickling filter, RBC, Anaerobic decomposition, Adsorption, ion exchange, chemical oxidation.

MODULE-III **(11 Hours)**

Sources, Characteristics, waste water treatment flow sheets for selected industries such as Textile, Tannery, Pharmaceutical, Dairy, Sugar, Pulp and Paper, Distillery, Steel plants, Oil refineries, fertilizer

MODULE-IV **(11 Hours)**

Air Pollution Laws, Air pollutants monitoring equipment and method of analysis, Air pollution control methods in industries, sludge treatment and disposal.

Books for reference:

1. Industrial Pollution Control, W.W. Eckenfelder, McGraw Hill International Edition.
2. Industrial Wastewater Treatment, Patwardhan, PHI.
3. Industrial Pollution Control, Nancy J Sell, Wiley eastern limited
4. Mahajan S.P., Pollution Control in Process Industries, Tata Mcgraw Hill
5. Air pollution Control Engineering, Noel De Nevers, Mcgrawhill Int Edition.

Course Outcomes: At the end of the course, students will be able to

1. Understand various terms used in industrial wastewater treatment and to acquaint with different steps involved in treatment of industrial wastewater.
2. Learn physical/chemical/biological characteristics of and the evaluation technique for various industrial wastewaters.
3. Understand the theory, engineering application, and design technique for the industrial wastewater treatment unit processes.
4. Design various air pollution control equipments.

ENE203	Occupational Health and Safety	3-0-0	Credits 3

MODULE-I **(11 Hours)**

Occupational Health and Safety concern and problems. National and international protocols and concerns, policies and legislation. Ergonomics; Stress-strain concept;

MODULE-II **(9 Hours)**

Assessment of human capabilities and limitations; Human Physiological Work Capacity and its evaluation. Sources of work stress (a) intrinsic to the jobs, (b) work environmental stressors like heat & Humidity , noise & vibration, dust, illumination, etc

MODULE-III **(11 Hours)**

Methodologies for evaluating different types of stresses. Human Error and Accidents: Different Classification of Human Error, Theories of Accident Causation, Human Error Audit. Accident analysis.

MODULE-IV **(11 Hours)**

Education and Training in Occupational Hygiene. Need to evolve an integrated Occupational Health and Safety Programme for specific industries. Occupational Health & Safety Management Systems (OHSAS - 18001): Legal and other Requirements ; Overview; Planning, hazard identification and risk assessment; Occupation Health and Safety Policy; OH & SMS Documentation; Emergency Preparedness and Response.

Books and Reference

1. Dan Petersen, "Techniques of Safety Management", McGraw-Hill Company, Tokyo, 1981.
2. Relevant India Acts and Rules, Government of India.
3. Relevant Indian Standards and Specifications, BIS, New Delhi.
4. Blake R.B., "Industrial Safety" Prentice Hall, Inc., New Jersey, 1973.
5. Safety and Good House Keeping", N.P.C., New Delhi, 1985.
6. Accident Prevention Manual for Industrial Operations", N.S.C.Chicago, 1982.

Course Outcomes: At the end of the course, students will be able to

1. Gather knowledge about occupational health problems for workers.
2. Apply Industrial safety measures in case of an work related accident.
3. Know about the level of exposure of worker during industrial operations.

ENE204	Environmental Hydraulics	3-0-0	Credits 3

MODULE-I **(11 Hours)**

Ground water and well hydraulics: steady and unsteady radial flows in aquifers (confined, unconfined), effect of well bore storage, multiple well systems, partially penetrating wells, bounded aquifers, characteristic well losses, and estimation of aquifer parameters.

MODULE-II **(9 Hours)**

Fluid flow - continuity principle, energy principle and momentum principle; frictional head loss in free and

pressure flow Flow through Pipes: Major and minor losses of energy in pipes , Hydraulic gradient and total energy line,

Flow through pipes in series, in parallel, equivalent pipe, Flow through branch pipe. Water Distribution network analysis – Hardy cross and Equivalent pipe method.

MODULE-III **(11 Hours)**

Open channel hydraulics: open channel flow and its classifications, and properties, energy and momentum principles, Critical flow computation and its applications, transitions with sub critical and super critical flows uniform flow, gradually varied flow, Most efficient channel section.

MODULE-IV **(11 Hours)**

Water Distribution network analysis – Hardy cross and Equivalent pipe method. Hydraulic design of sewers and sewerage network.

Books for reference:

1. Fluid Mechanics, A.K. Jain, Khana Publishers.
2. Hydraulics and Fluid Mechanics, Modi and Seth, Standard Book House.
3. Open Channel Flow, Subramanya, Mcgraw-Hill Publishing Co.
4. Ground Water Hydrology, Raghunath, Wiley Eastern limited.

Course Outcomes: At the end of the course, students will be able to

1. Use transport models for contaminant transport for ground water and surface water.
2. Apply basic fluid mechanics principles in the analysis and design of pipe flow.
3. Analyse and design pipe networks.
4. Solve well hydraulics problems.
5. Gather knowledge on open Channel flow

ENE205	Engineering Hydrology	3-0-0	Credits 3

MODULE-I **(11 Hours)**

Hydrological cycle, Rainfall –Runoff data analysis, Precipitation, Evaporation, Evapotransporation, Measurement of Evaporation, Infiltration, Stream flow measurement.

MODULE-II **(9 Hours)**

The ground water environment, Aquifer, Aquitard, Darcy's law, Permeability, Development of Lap lace's basic ground water flow equation, Aquifer parameter, Well hydraulics – steady and unsteady flow equation, Jacob's Thies equation, Well functions, Ground water flow between water bodies.

MODULE-III **(11 Hours)**

Unit hydrograph, S-Hydrograph, Application of Hydrographical data for flood estimation, Gumbel's approach, Meskingham's equation, salt water intrusion and modeling

MODULE-IV **(11 Hours)**

Ground water pollution, Transport of contaminates, advection, diffusion, Adsorption model, Numerical modeling and solution, Artificial recharge and rainwater harvesting.

Books for reference:

1. 1.Subramanyam - Engineering Hydrology
2. K.C. Patra – Hydrology
3. Sing. V.P – Elementary Hydrology
4. D.K.Todd – Ground Water Hydrology
5. Bear & Gaeob – Hydrology of Ground Water.
6. K.S. Reddy – Geo-Environmental Engineering
7. Raghunath - Ground Water Hydrology
8. Viesmann – Hydrology – Prentice Hall
9. Beers and Rowe- Ground water flow modeling

Course Outcomes: At the end of the course, students will be able to

1. Understand theories and concepts in surface and subsurface hydrology, the physical, chemical and biological interactions between the hydrosphere, the lithosphere, the biosphere and the atmosphere.
2. Evaluate and analyze hydrological systems and processes at a wide range of scales in both space and time for the purpose of water resources assessment, natural hazard assessment and mitigation, and environmental planning and management.

ENE206	Application of Remote Sensing and GIS for Environmental Studies	3-0-0	Credits 3

MODULE-I **(11 Hours)**

Introduction to Remote Sensing: Principles of Remote sensing, Types of Remote Sensing, Advantages of Remote Sensing, Physical basis of Remote Sensing,

Applications of Remote Sensing: History of Remote Sensing; The Electromagnetic spectrum; The nature and generation of Electromagnetic radiation (EMR) Spectral Reflectance Curves. Interaction of EMR with the atmosphere and earth's surface features. Spectral signatures and characteristics, spectral reflectance curves for rocks, soil, vegetation and water features within near and near Infrared. Spectral signatures, Resolution.

MODULE-II **(9 Hours)**

Remote Sensing observations and platforms: Ground, airborne and satellite based platforms; Some important Remote Sensing Satellites. Aerial Stereo coverage and Remote Sensing Satellites.

Sensors: Passive and Active Sensors; Major Remote Sensing Sensors; single and multi-band scanners Satellite band designations and principal applications; Colour / False Colour; Aerial Photography/ Aerial Photo Interpretation. USS sensor and other type of sensors. Details of sensors on board latest Earth resources Satellites viz.; LANDSAT 6/7/8, SPOT, IKONOS, IRS and ERS.

MODULE-III **(11 Hours)**

Digital Image Processing: Pixels and Digital Number; Digital Image Structure; Format of Remote Sensing Data; Image Processing functions: Image Restoration, Image Enhancement, Image Transformation, Image Classification and Analysis; Image interpretation strategies. Visual Photo- Interpretation Techniques based on 'Photo elements' and 'Terrain elements'.

MODULE-IV **(11 Hours)**

Geographic Information System: Introduction, Definition, Preparation of thematic map from remote sensing data, Map Projection and Co-ordinate system, GIS components: Hardware, software and infrastructures, GIS data types, Data acquisition, Data Input and Data Processing, and management including topology DEM/ DTM generation.

Integration of Remote Sensing and GIS techniques and its applications in Environmental Impact Assessment and Management including some case studies.

Books and Reference:

1. Remote Sensing and GIS - Anji Reddy M., The Book Syndicate, Hyderabad, 2000.
2. Principles of Geographical Information Systems - P A Burrough and R. A. McDonnell, OUP, Oxford, 1998.
3. Remote Sensing for Earth Resource- Rao, L.P., AEG Publication, Hyderabad, 1987.
4. Geographic Information System- Kang Tsung Chang, Tata Mc Graw Hill, Publication Edition, 2002.
5. Remote Sensing And Image Interpretation Thomas M. Lillesand, Ralph W. Kiefer, Jonathan W. Chipman, Wiley,2003
6. Journal by Insurance Company.

Course Outcomes: At the end of the course, students will be able to

1. Apply remote sensing in solving environmental problems.

2. Use GIS software to locate and design environmental pollution control units.
3. Apply remote sensing and GIS data in environmental remediation and EIA studies.

ENC203	Environmental Monitoring Lab II	0-0-4	Credits 2

Syllabus

Physical, chemical and biological analysis of water and wastewater (instrumental methods).

Measurement of particulate and gaseous air pollutants.

No of Lectures: 28 Hours

Books for reference:

1. Standard Methods for Examination of Water and Wastewater, APHA, USEPA

Course Outcomes: At the end of the course, students will be able to

1. Gather Knowledge about various instrumental methods of environmental Chemical analysis.
2. Design their own laboratory setup and perform their research.
3. Set up air pollution monitoring stations.

ENC204	Environmental Engineering Design II	0-0-4	Credits 2

Syllabus

Complete design of wastewater treatment unit, analysis and design of sewerage network.

Design of air pollution control devices

No of Lectures: 28 Hours

Books for reference:

1. Sewage Disposal and Air Pollution Engineering, S.K. Garg, Khana Publishers.
2. Wastewater Engineering, B.C. Punmia, Laxmi Publications.
3. Wastewater, Treatment, Disposal and Reuse, Mtcalf & Eddy
4. Water and Wastewater Technology, Hammer & Hammer, PHI

Course Outcomes: At the end of the course, students will be able to

1. Design various wastewater treatment Units.
2. Analyse and design sewerage network.
3. Design air pollution control devices

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

M.TECH SYLLABUS for *Specialization*: GEOTECHNICAL ENGINEERING

BRANCH: CIVIL ENGINEERING (2018-19 Admission Batch)

First Semester				Second Semester			
Theory				**Theory**			
Course Code	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**	**Course Code**	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**
	Programme Core-1	3-0-0	3		**Programme Core-3**	3-0-0	3
GTC101	Theory of Elasticity and Plasticity			GTC201	Advanced Geo-Mechanics		
	Programme Core-2	3-0-0	3		**Programme Core-4**	3-0-0	3
GTC102	Fundamentals of Soil Behaviour			GTC202	Finite Elements in Geo-Mechanics		
	Programme Elective-1 (Any One)	3-0-0	3		**Programme Elective-3 (Any One)**	3-0-0	3
GTE101	Advanced Foundation Engineering			GTE201	Soil Dynamics & Geotechnical Earthquake Engineering		
GTE102	Soil Structure Interaction			GTE202	Stability Analysis of Slopes, Embankments & Dams		
GTE103	Foundation on Expansive Soils			GTE203	Subsoil Exploration and Soil Testing		
	Programme Elective-2 (Any One)	3-0-0	3		**Programme Elective-4 (Any One)**	3-0-0	3
GTE104	Earth Retaining Structures			GTE204	Reinforced Soil Structures		
GTE105	Optimization Methods and its Applications in Civil Engineering			GTE205	Rock Mechanics		
GTE106	Advanced Numerical Methods			GTE206	Ground Improvement Techniques		
GHM101	Research Methodology & Intellectual Property Rights	2-0-0	2				
	Audit Course-1 (Any One from the list of Audit Courses)	2-0-0	0		**Audit Course-2 (Any One from the list of Audit Courses)**	2-0-0	0
	Total (Theory)	**16**	**14**		**Total (Theory)**	**14**	**12**
	Practical/ Sessional				**Practical/ Sessional**		
	Lab-1	0-0-4	2		**Lab-3**	0-0-4	2
GTC103	Geotechnical Engineering Laboratory			GTJ201	Seminar		
	Lab-2	0-0-4	2		**Lab-4**	0-0-4	2
GTC104	Computational Geo-techniques Laboratory			GTC203	Geotechnical Engg Design Practice		
				GTJ202	**Mini Project with Seminar**	0-0-4	2
	Total (Practical/ Sessional)	**8**	**4**		**Total (Practical/ Sessional)**	**12**	**6**
	TOTAL	**24**	**18**		**TOTAL**	**26**	**18**
TOTAL SEMESTER CREDITS: 18				TOTAL SEMESTER CREDITS: 18			
TOTAL CUMULATIVE CREDITS: 18				TOTAL CUMULATIVE CREDITS: 36			

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M.TECH SYLLABUS for *Specialization*: GEOTECHNICAL ENGINEERING

BRANCH: CIVIL ENGINEERING (2018-19 Admission Batch)

Third Semester				Fourth Semester			
Theory				**Theory**			
Course Code	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**	**Course Code**	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**
	Programme Elective-5 (Any One)	3-0-0	3				
GTE301	Ground Water and Flow through Porous Media						
GTE302	Project Planning and Construction Management						
GTE303	Geo-environmental Engineering						
	Open Elective (Any One)	3-0-0	3				
	Business Analytics						
	Industrial Safety						
	Operations Research						
	Cost Management of Engineering Projects						
	Composite Materials						
	Waste to Energy						
	Internet of Things						
	Soft Computing						
	Project Engineering & Management						
	Start-up & Entrepreneurship Development						
	Total (Theory)	**6**	**6**		**Total (Theory)**	**0**	**0**
	Practical/ Sessional				**Practical/ Sessional**		
GTJ301	Dissertation Phase-I	0-0-20	10	GTJ401	Dissertation Phase-II	0-0-32	16
	Total (Practical/ Sessional)	**20**	**10**		**Total (Practical/ Sessional)**	**32**	**16**
	TOTAL	**26**	**16**		**TOTAL**	**32**	**16**
TOTAL SEMESTER CREDITS: 16				TOTAL SEMESTER CREDITS: 16			
TOTAL CUMULATIVE CREDITS: 52				TOTAL CUMULATIVE CREDITS: 68			

List of Audit courses

1	AHM101	English for Research Paper Writing
2	ACE101	Disaster Management
3	AHM102	Sanskrit for Technical Knowledge
4	AHM103	Value Education
5	AHM104	Constitution of India
6	AHM105	Pedagogy Studies
7	AHM106	Stress Management by Yoga
8	AHM107	Personality Development through Life Enlightenment Skills

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

M.TECH SYLLABUS for *Specialization*: GEOTECHNICAL ENGINEERING

BRANCH: CIVIL ENGINEERING (2018-19 Admission Batch)

1st Semester

GTC101	Theory of Elasticity and Plasticity	3-0-0	Credits 3

Course Objectives:

1. Detailed knowledge of elastic constants and their importance.
2. Detailed knowledge of stress and strain and their relation
3. Behaviour of materials under different loading conditions.

MODULE-I

Linear elasticity; stress, strain, constitutive relations, strain displacement relations, three dimensional stress and strain analysis, compatibility, stress and displacement functions.

MODULE-II

Two dimensional problems in Cartesian and polar coordinates, description of an elasticity problem as a boundary value problem, bending of beams-cantilever and simply supported beam.

MODULE-III

Torsion of rectangular bars including hollow sections, torsion of a circular and a rectangular section

MODULE-IV

Elements of plasticity, failure & yield criterion, Equations of plasticity, plastic stress-strain relations, flow rule, velocity field, slip lines and plastic flow, incremental plasticity.

Text/Reference Books:

1. S.P.Timoshenko& J.N.Goodier,"Theory of Elasticity", McGraw Hill-1970.
2. M.Kachanov, "Theory of Plasticity", MIR Publication.
3. C.R.Calladine, "Plasticity for Engineers", Ellis Horwood, Chichester,U.K.,1985

Course Outcomes:

1. Ability to understand the use of elastic constants.
2. Understand the strength and deformation aspect in design of a structure or its parts.
3. Understand the mode of failure of materials under different loads.

GTC102	Fundamentals of Soil Behaviour	3-0-0	Credits 3

Course Objectives:

1. Detailed knowledge of the clay minerals.
2. Detailed knowledge of the strength and deformation behaviour of soil
3. Information on advancements in the above areas.

MODULE-I

Soil minerals, coarse- and fine-grained soils, Bonding and inner particles forces, clay mineralogy, atomic bonds, clay water relations, clay particles in aqueous suspension, flocculation and dispersion of clay minerals, electrical effects, clay mineral identification.

MODULE-II

Consolidation, consolidation test and interpretation, swelling, secondary consolidation and its effects - pre-consolidation pressure, consolidation by sand drains, free strain and equal strain case effect of smear zone. Evaluation of soil settlement, settlement prediction in sand, simplified strain influence factor, Settlement of normally consolidated and over-consolidated clay, pre-compression for improving foundation.

MODULE-III

Shear strength, stress strain relationships. Direct shear test, Triaxial tests, volumetric behaviour, critical void ratio, liquefaction, effect of rate of strain on undrained shear test, Rendaulic plot, Drained and undrained strength parameters, sensitivity and thixotropy, porewater pressure due to undrained loading and isotropic stress application – Skempton's pore pressure parameters, Henkel's modification. Stress paths. Compaction, compaction tests, zero air voidscurve, Field compaction equipment. Compaction control in field. Applications of compaction in field problems.

Text/Reference Books:

1. Mitchell, J.K. and Saga, K. (2005) Fundamentals of soil behaviour, John Wiley and Sons, NY.
2. Ayyar, T.S.R. (2003). Soil Engineering in Relation to Environment. L.B.S. Centre, Trivandrum.
3. Das, B.M. (2008). Advanced Soil Mechanics.Taylor and Francis, UK.
4. Lamb, T.W. and Whitman, R.V. (1979). Soil Mechanics, John Wiley and Sons, UK.
5. Terzaghi, K., Peck, R.B. and Mesri, G. (1996). Soil Mechanics in Engineering Practice. John Wiley and Sons, USA.
6. Powrie, W. (2004) Soil mechanics, Concepts and applications. Spon Press.
7. Craig, R.F. (2004) Soil Mechanics, Taylor and Francis, UK.

Course Outcomes:

1. Ability to understand clay minerals and their identification.
2. Understand the strength and deformation aspects of soil.
3. Understand the more recent developments in the understanding of soil behavior.

GTE101	Advanced Foundation Engineering	3-0-0	Credits 3

Course Objectives:

1. To determine the bearing capacity of soil and the probable settlement and also to select the type of depth of foundation for a project.
2. To import empirical knowledge of soil behaviour required by the geotechnical engineer for the design of foundation and other soil related structures.

MODULE-I

Shallow foundations- Geotechnical Design of foundations, Loads for design-Methods of estimating bearing capacity, Terzaghi's, Meyerhof's, Hansen's, Vesic's and I.S code equations, Comparison of various methods for estimation of bearing capacity, Effect of water table, eccentricity, and inclination of loading on Bearing Capacity, Footings on layered soils, Correlation of bearing capacity from penetration test data.

MODULE-II

Vertical stress distribution beneath footings and for loaded areas of various shapes, Different methods, Computation of settlements, immediate and consolidation settlement, Steinbrenner's method, Method of proportioning footings for equal settlement, construction period correction, Mat foundation, Modulus of subgrade reaction, Finite difference method.

MODULE-III

Pile foundations, selections of pile types , wooden piles, concrete piles, static pile capacity of single piles in clays and sands, Dynamic formulae, Pile driving, Pile driving stresses, Pile load test, Selection of design parameters, Types of strength parameters, Effect of installation and drainage conditions, Pile group efficiency, Negative skin friction on pile groups, Tension piles, Resistance of piles subjected to uplift forces, Laterally loaded piles, Ultimate lateral resistance of vertical piles by Brom's method, Settlement of pile groups in clays and sands, Influence of pile driving on adjacent structures.

Text/Reference Books:

1. Bowles, J. E, Foundation Analysis and Design, McGraw-Hill, New York, 2001.
2. Nayak, N.V, Foundation Design Manual, Dhanpat Rai Publications, New Delhi,1996.
3. Teng, W.C, Foundation Design, Prentice Hall, New Jersey, 1998.
4. Peck, R. B, Hanson, W. E, and Thornborn, T. H, FoundationEngineering, John Wiley & Sons, Inc., New York, 1974.
5. Braja, M. Das, Principles of Foundation Engineering, Global Engineering, USA, 2011.
6. Purushothama Raj, Soil Mechanics and Foundation Engineering, Dorling Kindersley (India) Pvt .Ltd., 2008.

Course Outcomes:

1. A comprehensive and well defined knowledge on bearing capacity theories is expected.
2. Also, an exposure on grey areas like the design of laterally loaded piles and sheet piles will be obtained.
3. Students are trained how to design the foundations of a particular project depending upon the Properties of soil and type of projects.
4. The students become competent enough to give general guide lines to the society and the problems or challenge related to geotechnical engineering.

GTE102	Soil Structure Interaction	3-0-0	Credits 3

Course Objectives:

1. Should be able to apply the effects of interaction between soil and foundation
2. The ability to apply the concepts for solving multi task applications

MODULE-I

Soil-Foundation Interaction: Introduction to soil-foundation interaction problems, Soil behaviour, Foundation behaviour, Interface behaviour, Scope of soil foundation interaction analysis, soil response models, Winkler, Elastic continuum, Two parameter elastic models, Elastic plastic behaviour, Time dependent behavior.

MODULE-II

Beam on Elastic Foundation- Soil Models: Infinite beam, two parameters, Isotropic elastic half space, Analysis of beams of finite length, Classification of finite beams in relation to their stiffness. Plate on Elastic Medium: Thin and thick plates, Analysis of finite plates, Numerical analysis of finite plates, simple solutions.

MODULE-III

Elastic Analysis of Pile: Elastic analysis of single pile, Theoretical solutions for settlement and load distributions, Analysis of pile group, Interaction analysis, Load distribution in groups with rigid cap.

MODULE-IV

Laterally Loaded Pile: Load deflection prediction for laterally loaded piles, Subgrade reaction and elastic analysis, Interaction analysis, Pileraft system, Solutions through influence charts.

Text/Reference Books:

1. Foundation Design by Teng W.C (1969), Prentice Hall, NJ.
2. Tomlinson M.J. (1986), Foundation Design and Construction, 5th edition, John Wiley, Newyork
3. Bowles J.E., Foundation Analysis and Design, 5th edition, Mc-GrawHill, Newyork

4. Tomlinson M. J., Pile Design and Construction Practice, 1977 Viewpoint publications, London
5. Desai, C. S., and Abel, J.F., Introduction to the Finite Element Method: A Numerical Method for Engineering Analysis, Van Nostrand Reinhold Co., New York, 1972. Tenth Reprint. Translated into Japanese and Chinese (Peking). Asian (Indian) Edition, Taiwanese Edition.
6. N.P. Kurien, Design of Foundation Systems: Principles & Practices, Narosa, New Delhi 1992.
7. E.S. Melerski, Design Analysis of Beams, Circular Plates and Cylindrical Tanks on Elastic Foundation, Taylor and Francis, 2006.
8. L.C. Reese, Single piles and pile groups under lateral loading, Taylor & Francis, 2000
9. G. Jones, Analysis of Beams on Elastic foundation, Thomas Telford, 1997

Course Outcomes:

1. Understand various theories involved in soil structure interaction
2. Understand capabilities of various models used to simulate the interaction
3. Understand the features of methods of analysis and apply them in real life applications

GTE103	Foundation on Expansive Soils	3-0-0	Credits 3

MODULE-I

Origin of expansive soils, Physical properties of expansive soils, Mineralogical composition, Identification of expansive soils, Field conditions that favor swelling, Consequences of swelling.

MODULE-II

Swelling characteristics, Laboratory tests, Prediction of swelling characteristics, Evaluation of heave.

MODULE-III

Horizontal moisture barriers, Vertical moisture barriers, Surface and subsurface drainage, rewetting, Soil replacement, Sand cushion techniques, CNS layer technique.

MODULE-IV

Belled piers, Bearing capacity and skin friction, Advantages and disadvantages, Design of belled piers, Under reamed piles, Design and construction.

MODULE-V

Lime stabilization, Mechanisms, Limitations, Lime injection, Lime columns, Mixing, Chemical stabilization, Construction.

Text/Reference Books:

1. Fu hua Chen, Foundations on Expansive Soils, Elsevier Scientific Publishing Company, New York.
2. GopalRanjan&A.S.RRao, Basic and Applied Soil Mechanics, New Age International Publishers – New Delhi.
3. Hand Book on Underreamed and Bored Compaction Pile Foundation, CBRI, Roorkee.
4. IS: 2720 (Part XLI) – 1977 – Measurement of Swelling Pressure of Soils.
5. R.K.Katti, Search for Solutions in Expansive Soils.
6. Alam Singh, Modern Geotechnical Engineering, Geo-Environ Academia, Jodhapur.
7. Swami Saran, Analysis and Design of Substructures, Oxford & IBH, New Delhi.

GTE104	Earth Retaining Structures	3-0-0	Credits 3

MODULE-I

Earth pressure, introduction, earth pressure as a stability problem, concept of strain dependence of developed stresses, active, at rest and passive conditions, plastic equilibrium, various theories related with E.P. Distillation, Rankine, Coulomb and Hansen theoretical derivation and graphical construction with different geometric and boundary conditions

MODULE-II

Retaining wall - types, material, method of construction, nature of forces acting.Comparison of different earth pressure theories and application in retaining wall. Stability analysis and design aspects, application of theory of elasticity in analysis of earth pressure distribution.

MODULE-III

Sheet pile and cofferdam. Type, material, method of construction, distribution of earth pressure and related approximation. Distinction between Sheet Pile and Retaining wall, analysis and design.

MODULE-IV

Earth - structure - Definition features of an earth dam, stability analysis of slope, total - vs. - effective stress analysis, limit equilibrium method of slices based on circular failure surfaces, introduction to analysis based on general failure surfaces, introduction to analysis based on general failure surfaces. Stability of earth dams during different stages - during and at end of construction, steady seepage, sudden draw down, estimation of pore water pressure, use of stability charts.

Text/Reference Books:

1. J.L. Sherard, R.J. Woodward, S.F. Gizienski, and W.A. Clevenger, Earth and Earth –Rock Dams Engineering Problems of Design and Construction, John Wiley and Sons, New York, 1963.

2. R F Craig, Soil Mechanics, Chapman and Hall (ELBS)
3. C. Justin and Hinds, Engineering for Dams Vol. 2 & 3.
4. S. Leliavsky, 'Design of Dams for Percolation and Erosion', Chapman and Hall.

Course Outcomes:

1. The students will be able to do analysis and design of different types of retaining structures

GTE105	Optimization Methods and its Applications in Civil Engineering	3-0-0	Credits 3

MODULE-I

Introduction: Need for engineering optimal design, Optimum design formulation: Design variable, objective function and constraints;

MODULE-II

Unconstrained optimization methods Single variable optimization methods: Region elimination method – Golden section search, Interval halving method; Gradient based method – Newton-Raphson, bisection and secant method. Multi variable optimization methods: Direct search method: Hooke-Jeeve pattern search, simplex reflection search, Powell's conjugate direction search. Gradient Based methods: Cauchy's steeped descent, Newton's method, Levenberg-Marquardt's method, Fletcher- Reeve method; Constrained optimization methods Kuhn.

MODULE-III

Tucker condition, Penalty function method, Augmented Lagrangian method, sequential unconstrained minimization, cutting plane method; Introduction to Evolutionary algorithms: Need for evolutionary algorithms, Type of evolutionary methods, Introduction to Genetic algorithm (GA), Difference and similarities between GA and traditional methods. Basic operations of GA: reproduction, crossover, mutation and elitism.

MODULE-IV

Binary coded and Real coded GA; Application of Optimization techniques: Water resource planning management, Structural Optimization, Transportation planning and Management, Slope stability and optimal dimensioning of foundations. multi-objective optimization models.

Text/Reference Books:

1. J.S. Arora, Introduction to Optimum Design, Elsevier, 2nd Edition, 2004.
2. K. Deb, Optimization for Engineering. Design: Algorithms & Examples, Prentice Hall India, 2006
3. S.S. Rao, Engineering Optimization: Theory & Practice, New Age International (P) Ltd, 3rd Edition, 1996, Reprint: June, 2008
4. K. Deb, Multi-Objective Optimization Using Evolutionary Algorithms, John Wiley, 2003

GTE106	Advanced Numerical Methods	3-0-0	Credits 3

MODULE-I

Introduction to digital computers & Programming: Errors - polynomial approximations and interpolations - Numerical differentiation & Integration;

MODULE-II

Evaluation of single and multiple integrals, Newton's method, variational and weighted residual methods, Matrices – Linear equations, Eigenvalues and Eigenvectors – nonlinear equations, different methods of solution of eigen value problems

MODULE-III

Harmonic and bi harmonic equations: solutions, convergence, completeness & stability.

MODULE-IV

Initial and boundary value problems of finite difference method, Implicit & Explicit scheme

Text/Reference Books:

1. Jain M.K, SRK Iyenge and RK Jain."Numerical Methods for Scientific &Engg. Computation".
2. Mathews J. H "Numerical Methods for Mathematics, Science and Engineering".
3. Gerald C.F and PO Wheatley "Applied Numerical Analysis".
4. Gupta S.C and V. K. Kapoor "Fundamentals of Applied Statistic", Sultan Chand &Sons.
5. Johnson R.A "Probability and Statistics for Engineers."
6. Rajeshwaran S, "Numerical Methods in Science & Engineering (A Practical Approach)", Willey Publication.

GTC103	Geotechnical Engineering Laboratory	0-0-4	Credits 2

Grain size analysis of fine and coarse grained soil, Atterberg limit, Light and heavy Compaction Test; Permeability of fine grained soils; Direct Shear Test; Unconfined compression tests: Triaxial Shear Test (CU, CD, UU); C.B.R (Unsoaked& Soaked); Consolidation Test;

GTC104	Computational Geo-techniques Laboratory	0-0-4	Credits 2

Introduction to MATLAB, ANSYS and some Geotechnical free softwares (DEEPSOIL, FLUSH, GEO-STUDIO, L-PILE, etc.) to solve problems related to Civil Engineering/Geotechnical Engg.

GHM101	Research Methodology & Intellectual Property Rights	2-0-0	Credits 2

MODULE-I **(06 Hours)**

Meaning of research problem, Sources of research problem, Criteria characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.

Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

MODULE-II **(04 Hours)**

Effective literature studies approaches, analysis,

Plagiarism, Research ethics.

MODULE-III **(04 Hours)**

Effective technical writing, how to write report, Paper.

Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

MODULE-IV **(06 Hours)**

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

MODULE-V **(04 Hours)**

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

MODULE-VI **(04 Hours)**

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Text/Reference Books:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science& engineering students'".
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.
5. Mayall, "Industrial Design", McGraw Hill, 1992.
6. Niebel, "Product Design", McGraw Hill, 1974.
7. Asimov, "Introduction to Design", Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016.
9. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

Course Outcomes: At the end of the course, students will be able to

1. Understand research problem formulation.
2. Analyze research related information
3. Follow research ethics
4. Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property.

   Right to be promoted among students in general & engineering in particular.
6. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Audit Courses

AHM101	English for Research Paper Writing	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Understand that how to improve your writing skills and level of readability
2. Learn about what to write in each section
3. Understand the skills needed when writing a Title

   Ensure the good quality of paper at very first-time submission

MODULE-I **(4 Hours)**

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

MODULE-II **(4 Hours)**

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction.

MODULE-III **(4 Hours)**

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

MODULE-IV **(4 Hours)**

key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed whenwriting a Review of the Literature.

MODULE-V **(4 Hours)**

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions.

MODULE-VI **(4 Hours)**

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

Suggested Studies:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book.

4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

ACE101	Disaster Management	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

MODULE-I **(4 Hours)**

Introduction

Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

MODULE-II **(4 Hours)**

Repercussions of Disasters and Hazards:

Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem.

Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

MODULE-III **(4 Hours)**

Disaster Prone Areas In India

Study of Seismic Zones; Areas Prone To Floods And Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics

MODULE-IV **(4 Hours)**

Disaster Preparedness and Management

Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data From Meteorological and Other Agencies, Media Reports: Governmental and

Community Preparedness.

MODULE-V **(4 Hours)**

Risk Assessment

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategiesfor Survival.

MODULE-VI **(4 Hours)**

Disaster Mitigation

Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation In India.

Text / Reference Books:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies", New Royal book Company.
2. Sahni, Pardeep Et. Al. (Eds.)," Disaster Mitigation Experiences and Reflections", Prentice Hall of India, New Delhi.
3. Goel S. L., Disaster Administration and Management Text and Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi.

AHM102	Sanskrit for Technical Knowledge	2-0-0	Credits 0

Course Objectives:

1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. Learning of Sanskrit to improve brain functioning
3. Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power
4. The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature

MODULE-I **(8 Hours)**

- Alphabets in Sanskrit
- Past/Present/Future Tense
- Simple Sentences

MODULE-II **(8 Hours)**

- Order
- Introduction of roots
- Technical information about Sanskrit Literature

MODULE-III **(8 Hours)**

- Technical concepts of Engineering-Electrical, Mechanical,Architecture, Mathematics

Suggested reading:

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

Course Output: Students will be able to

1. Understanding basic Sanskrit language
2. Ancient Sanskrit literature about science & technology can be understood
3. Being a logical language will help to develop logic in students

AHM103	Value Education	2-0-0	Credits 0

Course Objectives: Students will be able to

1. Understand value of education and self- development
2. Imbibe good values in students
3. Know about the importance of character

MODULE-I **(6 Hours)**

- Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism.
- Moral and non- moral valuation. Standards and principles.
- Value judgements

MODULE-II **(6 Hours)**

- Importance of cultivation of values.

- Sense of duty.Devotion, Self-reliance.Confidence, Concentration. Truthfulness, Cleanliness.
- Honesty, Humanity.Power of faith, National Unity.
- Patriotism.Love for nature, Discipline

MODULE-III **(6 Hours)**

- Personality and Behavior Development - Soul and Scientific attitude.
- Positive Thinking. Integrity and discipline.
- Punctuality, Love and Kindness.
- Avoid fault Thinking.
- Free from anger, Dignity of labour.
- Universal brotherhood and religious tolerance.
- True friendship.
- Happiness Vs suffering, love for truth.
- Aware of self-destructive habits.
- Association and Cooperation.
- Doing best for saving nature

MODULE-IV **(6 Hours)**

- Character and Competence –Holy books vs Blind faith.
- Self-management and Good health.
- Science of reincarnation.
- Equality, Nonviolence, Humility, Role of Women.
- All religions and same message.
- Mind your Mind, Self-control.
- Honesty, Studying effectively

Text / Reference Books

1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

Course outcomes: Students will be able to

1. Knowledge of self-development
2. Learn the importance of Human values
3. Developing the overall personality

AHM104	Constitution of India	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutionalrole and entitlement to civil and economic rights as well as the emergence of nationhood inthe early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the BolshevikRevolution in 1917 and its impact on the initial drafting of the Indian Constitution.

MODULE-I **(4 Hours)**

- **History of Making of the Indian Constitution:**

  History

  Drafting Committee, (Composition& Working)

MODULE-II **(4 Hours)**

- **Philosophy of the Indian Constitution:**

  Preamble

  Salient Features

MODULE-III **(4 Hours)**

- **Contours of Constitutional Rights & Duties:**

  Fundamental Rights

  Right to Equality

  Right to Freedom

  Right against Exploitation

  Right to Freedom of Religion

  Cultural and Educational Rights

  Right to Constitutional Remedies

  Directive Principles of State Policy

  Fundamental Duties.

MODULE-IV **(4 Hours)**

- **Organs of Governance:**

Parliament

Composition

Qualifications and Disqualifications

Powers and Functions

Executive

President

Governor

Council of Ministers

Judiciary, Appointment and Transfer of Judges, Qualifications

Powers and Functions

MODULE-V **(4 Hours)**

- **Local Administration:**

District's Administration head: Role and Importance,

Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation.

Pachayati raj: Introduction, PRI: ZilaPachayat.

Elected officials and their roles, CEO ZilaPachayat: Position and role.

Block level: Organizational Hierarchy (Different departments),

Village level: Role of Elected and Appointed officials,

Importance of grass root democracy

Model Curriculum of Engineering & Technology PG Courses [Volume -II]

MODULE-VI **(4 Hours)**

- **Election Commission:**

Election Commission: Role and Functioning.

Chief Election Commissioner and Election Commissioners.

State Election Commission: Role and Functioning.

Institute and Bodies for the welfare of SC/ST/OBC and women.

Text / Reference Books:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.

4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Outcomes: Students will be able to:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the passage of the Hindu Code Bill of 1956.

AHM105	Pedagogy Studies	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Review existing evidence on the review topic to inform programme design and policymaking undertaken by the DfID, other agencies and researchers.
2. Identify critical evidence gaps to guide the development.

MODULE-I **(4 Hours)**

- **Introduction and Methodology:**
- Aims and rationale, Policy background, Conceptual framework and terminology
- Theories of learning, Curriculum, Teacher education.
- Conceptual framework, Research questions**.**
- Overview of methodology and Searching.

MODULE-II **(2 Hours)**

- Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries.
- Curriculum, Teacher education.

MODULE-III **(4 Hours)**

- Evidence on the effectiveness of pedagogical practices
- Methodology for the in depth stage: quality assessment of included studies.
- How can teacher education (curriculum and practicum) and the school curriculum and guidance

materials best support effective pedagogy?

- Theory of change.
- Strength and nature of the body of evidence for effective pedagogical practices.
- Pedagogic theory and pedagogical approaches.
- Teachers' attitudes and beliefs and Pedagogic strategies.

MODULE-IV **(4 Hours)**

- Professional development: alignment with classroom practices and follow up support
- Peer support
- Support from the head teacher and the community.
- Curriculum and assessment
- Barriers to learning: limited resources and large class sizes

MODULE-V **(2 Hours)**

- **Research gaps and future directions**

- Research design
- Contexts
- Pedagogy
- Teacher education
- Curriculum and assessment
- Dissemination and research impact.

Text / Reference Books:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2):245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal ofCurriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International JournalEducational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.

7. www.pratham.org/images/resource%20working%20paper%202.pdf.

Course outcomes: Students will be able to understand:

1. What pedagogical practices are being used by teachers in formal and informal classrooms indeveloping countries?
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, andwith what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

AHM106	Stress Management by Yoga	2-0-0	Credits 0

Course Objectives:

1. To achieve overall health of body and mind
2. To overcome stress

MODULE-I **(8 Hours)**

- Definitions of Eight parts of yoga. (Ashtanga)

MODULE-II **(8 Hours)**

- Yam and Niyam.

  Do`s and Don't's in life.

  i) Ahinsa, satya, astheya, bramhacharya and aparigraha

  ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

MODULE-III **(8 Hours)**

- Asan and Pranayam

  i) Various yog poses and their benefits for mind & body

  ii) Regularization of breathing techniques and its effects-Types of pranayam

Text / Reference Books:

1. 'Yogic Asanas for Group Tarining-Part-I" :Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

Course outcomes: Students will be able to:

1. Develop healthy mind in a healthy body thus improving social health also
2. Improve efficiency

AHM107	Personality Development through Life Enlightenment Skills	2-0-0	Credits 0

Course Objectives:

1. To learn to achieve the highest goal happily
2. To become a person with stable mind, pleasing personality and determination
3. To awaken wisdom in students

MODULE-I **(8 Hours)**

Neetisatakam-Holistic development of personality

- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)
- Verses- 52,53,59 (dont's)
- Verses- 71,73,75,78 (do's)

MODULE-II **(8 Hours)**

Approach to day to day work and duties.

- Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48,
- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,
- Chapter 18-Verses 45, 46, 48.

MODULE-III **(8 Hours)**

Statements of basic knowledge.

- Shrimad Bhagwad Geeta: Chapter 2- Verses 56, 62, 68
- Chapter 12 - Verses 13, 14, 15, 16,17, 18
- Personality of Role model. Shrimad Bhagwad Geeta: Chapter 2-Verses 17, Chapter 3-Verses 36,37,42,
- Chapter 4- Verses 18, 38,39
- Chapter18 – Verses 37,38,63

Text / Reference Books:

1. "Srimad Bhagavad Gita" by Swami SwarupanandaAdvaita Ashram (PublicationDepartment), Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

Course outcomes: Students will be able to:

1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achievethe highest goal in life
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity
3. Study of Neetishatakam will help in developing versatile personality of students.

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

M.TECH SYLLABUS for *Specialization*: GEOTECHNICAL ENGINEERING

BRANCH: CIVIL ENGINEERING (2018-19 Admission Batch)

2nd Semester

GTC201	Advanced Geo-Mechanics	3-0-0	Credits 3

MODULE-I

Soils, rocks and groundwater: Geology and genesis of soils and Soil formation- Types of soils and their characteristics; Particle sizes and shapes, their impact on engineering properties, Soil-air-water interaction; Concept of effective stress principle of effective stress, indices and phase relationships, soil-water behaviour.

MODULE-II

Stress and strain analysis: Stress strain relationships. Definition of stress and strain tensors.Elasticity.Linear Elasticity, Generalized Hooke's law.Critical state soil mechanics: Critical State Line, Hvorslev Surface, Yield Surfaces: Modified Cam-clay and Original Camclay; Elastic and plastic analysis of soil:- Constitutive relationships of soil; failure theories. Limit analysisUpper bound theorems, lower bound theorems, limit equilibrium methods

MODULE-III

Shear strength and stiffness of sands: stress-strain, volume change and shearing in sands, critical state and stress paths, consolidation.

MODULE-IV

Shear strength and stiffness of clays: compression and consolidation, drained and un-drained shear strength, critical state and stress paths.

Text Books:

1. B M Das, Advanced Soil Mechanics, Taylor and Francis

Reference Books:

1. Wood, D.M., Soil Behaviour and Critical State Soil Mechanics, Cambridge University Press, 1991.
2. Bolton, M.D., A Guide to Soil Mechanics, Cambridge University Press, 1991.
3. Salgado, R., The Engineering of Foundations, McGraw Hill, 2008.
4. Atkinson, 'Critical State Soil Mechanics'
5. McCarthy D.F., Essentials of Soil Mechanics & Foundations, Prentice-Hall, 2002.

GTC202	Finite Elements in Geo-Mechanics	3-0-0	Credits 3

MODULE-I

Basic concepts - Discretization of continuum, typical elements, the element characteristic matrix, element assembly and solution for unknowns - Applications.

MODULE-II

Changing nature of solid wastes and its impact on solid waste management, Solid wastes management-Generation, on-site storage, collection, separation, processing and disposal On-site storage methods-containers, their type, size and location.

MODULE-III

Isoparametric formulation – Isoparametric bar element – plane bilinear isoparametric element – refined elements – Numerical integration techniques.

MODULE-IV

Use of FEM to Problems in soils and rocks, Introduction to non-linearity. Description and application to consolidation, seepage and soil – structure interaction problems.

Text/Reference Books:

1. Cook, R.D., Malkus, D.S., and Plesha, M.E., Concepts and Applications of Finite Element Analysis, John Wiley, 1989.
2. Reddy, J.N., An Introduction to the Finite Element Method, McGraw Hill, 1984.
3. Chadrupatla, R.T., and Belegundu. A.D, Introduction to Finite Elements in Engineering, Third Edition, Prentice- Hall, 2006.
4. Rockey, K.C., Erans, H.R., Griffiths, D.W., and Nethercot, D.A., The Finite Element method, Grostry Lockwood Staples, London, 1975.
5. Rajasekaran, S., Finite Element Analysis in Engg Design, Wheller Publishing, Allahabad, 1993.
6. Smith, I.M., Programming the Finite Element Method with Application to Geomechanics, John Wiley and sons, New Delhi, 2000.
7. Gupta, O.P. Finite and Boundary Element Methods in Engineering, Oxford & IBH Publishing Co., Pvt. Ltd., New Delhi, 2000.
8. Rao, S.S. The finite element method in Engg, Butterworth - Heinemann, 1998.
9. Potts, D.M. and Zdramcovic, L., Finite Element analysis in Geotechnical Engineering - Application, Thomas Telford, 2001.
10. Shen, J. and Kushwaha. R.L., Soil-Machine Interaction - A finite element perspective, MoralDikker, Inc. 1998.

Course Outcomes:

1. Students can understand basic stress-strain relationship for soil and develop Stress deformation analysis.
2. Students can develop finite element formulation for different geotechnical problems including shallow foundation, seepage and consolidation problems.

GTE201	Soil Dynamics & Geotechnical Earthquake Engineering	3-0-0	Credits 3

MODULE-I

Soil Dynamics: Introduction: Soil mechanics and soil dynamics, problems of dynamic loading on soil structure. Theory of vibrations: Introduction, definitions, properties of simple harmonic motion, free vibrations of spring-mass system, Equations for free and forced vibrations with and without viscous damping.

MODULE-II

Dynamic Soil Properties: Introduction, measurement of dynamic soil properties (laboratory and field tests - Stress and strain controlled cyclic tri-axial tests, seismic reflection and refraction test, seismic up-hole/down hole test, dilatometer and pressure meter tests, seismic cone penetration test, suspension logging test), stress-strain behavior of cyclically loaded soils, strength of cyclically loaded soils.

MODULE-III

Geotechnical Earthquake Engineering: Introduction, background, seismic hazards; ground shaking, structural hazards, liquefaction, landslides, lifeline hazards, tsunami hazards, mitigation of seismic hazards, significant historical earthquakes. Seismology and earthquakes: Internal structure of the earth, continental drift and plate tectonics, faults, elastic rebound theory, other sources of seismic activity location of earthquakes, size of earthquakes (intensity, magnitude and energy).

Seismic Liquefaction: Introduction, Flow liquefaction and cyclic mobility, liquefaction susceptibility (historical, geologic, and compositional). Initiation of liquefaction due to excess pore water pressure, effects of liquefaction (alteration of ground motion, development of sand boils, settlement and instability).

MODULE-IV

Machine Foundations: Types of machines; Basic design criteria; Methods of analysis; Mass-Spring-Dashpot model; Elastic-Half-Space theory; Types of foundations; Modes of vibrations; Vertical, sliding, torsional (yawing) and rocking (and pitching) modes of oscillations; Design guidelines as per codes; Typical design problems.

Text/Reference Books:

1. Geotechnical Earthquake Engineering by Steven L. Kramer, Low Price Edition, Pearson Education.
2. Soil Dynamics by ShamsherPrakash, McGraw-Hill Book Company
3. Soil Behaviour in Earthquake Geo-technics by Kenji Ishihara, Clarendon Press, Oxford
4. Theory of Vibrations with Applications by W. T. Thomson and M. D. Dahleh, Low Price Edition, Pearson Education.
5. Foundations for industrial machines by K.G. Bhatia, D-CAD Publishers
6. Principles of Soil dynamics by B.M. Das and G.V. Ramana, Cengage Learning

Course Outcomes:

1. Students will learn vibration characteristics of different dynamic systems
2. Students will know the causes and quantification of earthquake.
3. Student will be exposed to the effect of earthquake and the design criterions to be followed for the design different geotechnical structures
4. Students will be acquainted with various tests for evaluation of dynamic properties of soil
5. Students will learn the analysis and design of various machine foundations.

GTE202	Stability Analysis of Slopes, Embankments & Dams	3-0-0	Credits 3

MODULE-I

Landslide phenomenon: Types and causes of slope failures, Practical applications; Stability analysis of infinite slopes with or without water pressures

MODULE-II

Stability analysis of finite and infinite slopes: concept of factor of safety, pore pressure coefficients, Mass analysis, Wedge methods, friction circle method; Method of slices, Bishop's method, Janbu's method

MODULE-III

Effect of seepage, submerged and sudden draw down conditions; Design of slopes incutting, Embankments and Earth dams

MODULE-IV

Site Investigation: Reconnaissance, Preliminary and detailed investigation,Investigation for foundations ; Advances in stability analysis of slopes.

Text/Reference Books:

1. L. W Abramson, T. S Lee, S Sharma and G M Boyce, Slope Stability and Stabilization Methods, Willey Interscience publications
2. B M Das, Principles of Geotechnical Engineering, Thomson Brooks/Cole
3. T W. Lambe and R V Whitman, Soil Mechanics, John Wiley & sons
4. V N S Murthy, Principles of Soil Mechanics and Foundation Engineering, UBS Publishers Private Ltd.

GTE203	Subsoil Exploration and Soil Testing	3-0-0	Credits 3

MODULE-I

Problems and phases of foundation investigations: Geophysical sounding, drilling and accessible explorations.

MODULE-II

Sample requirements, sampling methods and equipment handling, preservation and transportation of samples.

MODULE-III

Sample preparation, laboratory tests: Direct shear tests, Triaxial (static and cyclic) and simple shear testing under stress- and strain-control with pore pressure measurements.analysis of results and interpretation,

MODULE-IV

Performing various in-situ tests: SPT, CPT, DCPT, Pressuremeter, Seismic reflection and refraction test, Seismic cross hole test, Precautions and interpretation, site evaluation and reporting, block vibration test Plate load test.

Text/Reference Books:

1. Head, K.H., Manual of Soil Laboratory Testing, Vols. 1 to 3, 1981.
2. Compendium of Indian Standards on Soil Engineering, Parts 1 and II, 1987–1988.
3. Soil Mechanics by Lambe and Whitman, John Wiley and Sons. New York. (1969)

GTE204	Reinforced Soil Structures	3-0-0	Credits 3

MODULE-I

PRINCIPLES AND MECHANISMS OF SOIL REINFORCEMENT

Historical Background, Principles, Concepts and Mechanisms of reinforced earth.

MODULE-II

REINFORCING MATERIALS AND THEIR PROPERTIES

Materials used in reinforced soil structures, fill materials, reinforcing materials metal strips, Geotextile, Geogrids, Geomembranes, Geocomposites and Geojutes, Geofoam, Natural fibers - facing elements – Properties and methods of Testing.

MODULE-III

DESIGN OF SOIL REINFORCEMENT

Reinforcing the soil-Geotextiles and Geogrids – Embankments and slopes – reinforced walls – bearing capacity – Road way reinforcement – slop stabilization.Geotextiles - requirement for design of separation – Filtration – General behaviour - filtration behind retaining walll, under drains, erosion control and silt fence – drainage design – Liners for liquid containment – Geomembrance and Geosynthetic clay liners.

MODULE-IV

DURABILITY OF REINFORCEMENT MATERIALS

Measurement of corrosion factors, resistivity - redox potential, water content, pH, electrochemical corrosion, bacterial corrosion – influence of environmental factors on the performance of Geosynthetic materials.

Text/Reference Books:

1. Jewell, R.A., Soil Reinforcement with Geotextile, CIRIA, London, 1996.
2. Jones, C.J.F.P., Earth Reinforcement and Soil Structures, Earthworks, London, 1982.
3. Koerner, R.M., Designing with Geosynthetics, Third Edition, Prentice Hall, 1997.
4. Muller, W.W. HDPE Geomembrances in Geotechnics, Springer, New York 2007.
5. John, N.W.M., Geotextiles, John Blackie and Sons Ltd., London, 1987.
6. Gray, D.H., and Sotir, R.B., Biotechnical and Soil Engineering Slope Stabilization: A practical Guide for Erosion control, John Wiley & Son Inc., New York, 1996.
7. RamanathaAyyar , T.S., Ramachandran Nair, C.G. and Balakrishna Nair, N., Comprehensive Reference Book on Coir Geotextile, Centre for Development for Coir Technology, 2002.
8. SivakumarBabu, G.L., An Introduction to Soil Reinforcement and Geosynthetics, University Press (India), Pvt. Ltd., Hyderabad, 2006.

GTE205	Rock Mechanics	3-0-0	Credits 3

MODULE-I

Rock: Formation of rocks, Physical properties, Classification of rocks and rock masses, Static Elastic constants of rock;

MODULE-II

Rock Testing: Laboratory and Field tests; Discontinuities in Rock Masses: Discontinuity orientation, Effect of discontinuities on strength of rock;

MODULE-III

Strength Behaviour: Compression, Tension and Shear, Stress-Strain relationships, Rheological behavior;

MODULE-IV

Strength/ Failure Criterion: Coulomb, Mohr, Griffith theory of brittle strength and other strength criteria. Stresses in rock near underground openings; Application of rock mechanics in Civil Engineering: Rock tunneling, Rock slope stability, bolting, blasting, grouting and rock foundation design.

Text/Reference Books:

1. W. Farmer, Engineering Behavior of Rocks, Chapman and Hall Ltd.
2. R. E. Goodman, Introduction to Rock Mechanics
3. P.R. Sheorey, Empirical Rock Failure Criteria, Balkema, Rotterdam, 1997
4. V.S. Vutukuri and R D Lama, Hand Book on Mechanical Properties

Course Outcomes:

1. The students will be able to perform various laboratory tests on rock and classify rock mass.
2. Be able to predict strength of rock mass with respect to various Civil Engineering applications.

GTE206	Ground Improvement Techniques	3-0-0	Credits 3

MODULE-I

At the completion of the course the students will be able to understand the different typesof ground modification can be done depending upon the site condition, type and purposeof structure to be constructed.

MODULE-II

Mechanical modification, properties of compacted soil, compaction control tests. Hydraulic modification, dewatering systems, filtration, drainage and seepage control with geosynthetics, preloading and vertical drains, Electri-kinetic dewatering, chemical modification.

MODULE-III

Modification by admixtures, stabilization using industrial wastes, grouting, modification by inclusion and confinement, soil reinforcement, flexible geosysthetic sheet reinforcement, anchorage.

MODULE-IV

Reinforcement techniques, bearing capacity improvement, slope stability, retaining walls and pavements.

Text/Reference Books:

1. Hausmann, M.R., Engineering Principles of Ground Modification, McGraw Hill, 1990.
2. M C. R. Davies, F.Schlosser Ground improvement geosystems.
3. Jones, C.J.E.P., Reinforcement and Soil Structures, Butterworth Publications, 1996.
4. Koerner, R.M., Designing with Geosynthetics, Prentice Hall Inc. 1998.

Course Outcomes:

1. At the completion of the course the students will be able to understand the different types of ground modification can be done depending upon the site condition, type and purpose of structure to be constructed.

GTJ201	**Seminar**	**0-0-4**	**Credits 2**
Literature review, report writing, seminar presentation and viva voce.			

GTC203	**Geotechnical Engg Design Practice**	**0-0-4**	**Credits 2**
Design and analysis of various types Shallow and Deep Foundations, cantilever retaining structures and sheet pile manually and using various available softwares.			

GTJ202	**Mini Project with Seminar**	**0-0-4**	**Credits 2**
Literature review, Experimental / Numerical Modelling, Report writing, Presentation, viva voce.			

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BRANCH: CIVIL ENGINEERING (2018-19 Admission Batch)

3rd Semester

GTE301	Ground Water and Flow through Porous Media	3-0-0	Credits 3

MODULE-I

Soil Water: Modes of occurrence of water in soils. Adsorbed water, capillary water, Capillary potential, capillary tension and soil suction. Effective and Neutral pressures in soil;

MODULE-II

Flow through porous Media: Darcy's law and measurement of permeability in laboratory and field.

MODULE-III

Steady State flow solutions of LaPlace's equation, Plane problems, 3-dimensional problems, Partial cut-offs, uplift pressure, consolidation theory: one and three dimensional consolidation, Secondary consolidation.

MODULE-IV

Ground water Hydraulics: Water table in regular materials, Geophysical exploration for locating water table. Confined water, Equilibrium conditions, Non-equilibrium conditions, Water withdrawal from streams, Method of ground water imaging.

Text/ Reference Books:

1. D.K.Todd, Groundwater Hydrology, Johnwiley and Sons
2. H. M. Raghunath, Ground Water, Willy Eastern Ltd.
3. C. Fitts, Ground Water Science, Elsevier Publications, U. S. A.
4. P. P. Raj, Geotechnical Engineering, Tata McGraw-Hill
5. A.Jumikis, Soil Mechanics, East West Press Pvt Ltd.

GTE302	Project Planning and Construction Management	3-0-0	Credits 3

MODULE-I

Introduction: Definition, Objective, functions and scope of construction management; Resources for Construction, Types of Construction, stages in construction, scientific methods of management; construction

team.

Construction Contracts and Specifications: Types of construction contracts; contract documents; specifications; general and special conditions of contract; contract management; arbitration and settlement.

Construction Planning: Construction Planning methodology, Stages of planning: -Pre-tender planning; contractplanning; planningand scheduling construction jobs by bar charts; Limitations of Bar Charts. Preparation of Man, Machine, Material and Money schedule.

MODULE-II

Network Techniques in Construction Management: Necessity of Network Technique in Construction planning and Management. Types of Network technique. Difference between PERT & CPM. Elements of Network: -Event, Activity, Dummy. Network Rules, Methods of Numbering the Events. Work Breakdown Structure.

PERT- Time Computations: - earliest Expected Time (T_E), Latest Allowable Occurrence Time (T_L). Combined Tabular computations for T_E and T_L. PERT-Network Analysis: -Slak, Critical path. CPM- Neywork Analysis: Activity, Expected Time (T_E), Latest Allowable Occurrence Time (T_L). Combined Tabular computations for T_E and T_L. Float, Critical activity and critical path. Allocation of resources. Computer software for network analysis.

Time Cost Optimization: Direct cost, indirect cost, total cost; purpose, stages and methods of cost control techniques of time cost optimization; examples and case studies.

MODULE-III

Site Lay-Out: Principles governing site lay out; factors affecting site lay out; preparation of site lay out. Supervision, Inspection and Quality Control: Supervisor's responsibilities; keeping records; control of field activities handling disputes and work stoppages; storage and protection of construction materials and equipment; testing and quality control. Purpose of inspection: Inspection of various components of construction; reports and records; statistical quality control.

Safety In Construction: Safety: importance of safety, accident-prone situations at construction site i.e, safety measures for excavation, drilling/blasting, scaffolding/formwork, hoisting &erection demolition and hot bituminous work. Fire Safety: Safety record of construction industry, safety campaign.

MODULE-IV

Labour Laws and Acts: Wages of construction Labours, Trade unions connected with the Construction Industries, Trade union Act-1926. Labour Welfare Fund Act-1965, Payment of Wages Act, Minimum Wage Act-1948, Contract Labour act.

Project Management: Feasibility study; project reports; progress reports; monitoring and controlling project activities.

Text/Reference Books:

1. Construction Planning and Management By – P.S.Gahlot and B.M. Dhir.
2. Project Planning and Control with PERT and CPM by- Dr B.C. Punmia and K.K. Khandelwal.
3. Challahan, M.T., Construction Project Scheduling.

4. Srinath, L.S.PERT and CPM-Concepts and Applications.
5. Austen: Managing Construction Projects, A guide to Processes & Procedures International Labour office, Geneva
6. Douglas and Manager: Construction Management, Prentice Hall
7. Roberts, J.M. Construction Management - An effective Approach.
8. O'Brien: CPM in Construction Management, McGraw Hill

GTE303	Geo-environmental Engineering	3-0-0	Credits 3

MODULE-I

Source, production and classification of wastes.

MODULE-II

Soil pollution processes, physical-chemical and biological interactions in soil, effects on geotechnical properties and case studies, waste disposal facilities such as landfills and impoundments, slurry walls, etc.

MODULE-III

Barrier systems – basic concepts, design and construction, stability, compatibility and performance.

MODULE-IV

Transport in subsurface, reuse of waste materials. Contaminated site remediation.

Text/Reference Books:

1. Daniel, D.E., Geotechnical Practice for Waste Disposal, Chapman and Hall, London, 1993.
2. Reddi, L.N., and Inyang, H.F., Geoenvironmental Engineering–Principles and Applications, Marcel Dekker, Inc., 2000.
3. Sharma, H.D., and Lewis, S.P., Waste Containment Systems, Waste Stabilization and Landfills: Design and Evaluation, John Wiley and Sons Inc. NY, 1994.

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

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BRANCH: CIVIL ENGINEERING (2018-19 Admission Batch)

First Semester				Second Semester			
Theory				**Theory**			
Course Code	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**	**Course Code**	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**
	Programme Core-1	3-0-0	3		**Programme Core-3**	3-0-0	3
STC101	Theory of Elasticity and Plasticity			STC201	Advanced Reinforced Concrete Design		
	Programme Core-2	3-0-0	3		**Programme Core-4**	3-0-0	3
STC102	Finite Element Analysis and its Applications			STC202	Theory of Plates & Shells		
	Programme Elective-1 (Any One)	3-0-0	3		**Programme Elective-3 (Any One)**	3-0-0	3
STE101	Advanced Steel Structures			STE201	Mechanics of Composite Materials		
STE102	Structural Dynamics			STE202	Bridge Engineering		
STE103	Prestressed Concrete			STE203	Earthquake Resistance Design of Structures		
	Programme Elective-2 (Any One)	3-0-0	3		**Programme Elective-4 (Any One)**	3-0-0	3
STE104	Advanced Numerical Methods			STE204	Advanced Construction Materials		
STE105	Repair & Rehabilitation of Structures			STE205	Optimization Methods & its Application in Civil Engineering		
STE106	Elastic Stability & Behavior of Metal Structures			STE206	Tall Structures		
GHM101	Research Methodology & Intellectual Property Rights	2-0-0	2		**Audit Course-2 (Any One from the list of Audit Courses)**	2-0-0	0
	Audit Course-1 (Any One from the list of Audit Courses)	2-0-0	0				
	Total (Theory)	**16**	**14**		**Total (Theory)**	**14**	**12**
	Practical/ Sessional				**Practical/ Sessional**		
	Lab-1	0-0-4	2		**Lab-3**	0-0-4	2
STC103	Advanced Concrete Lab – I			STC203	Advanced structural Lab – II		
	Lab-2	0-0-4	2		**Lab-4**	0-0-4	2
STC104	Computational Lab-I			STJ201	Seminar		
				STJ202	**Mini Project with Seminar**	0-0-4	2
Total (Practical/ Sessional)		**8**	**4**	**Total (Practical/ Sessional)**		**12**	**6**
TOTAL		**24**	**18**	**TOTAL**		**26**	**18**
TOTAL SEMESTER CREDITS: 18				TOTAL SEMESTER CREDITS: 18			
TOTAL CUMULATIVE CREDITS: 18				TOTAL CUMULATIVE CREDITS: 36			

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BRANCH: CIVIL ENGINEERING (2018-19 Admission Batch)

Third Semester				Fourth Semester			
Theory				**Theory**			
Course Code	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**	**Course Code**	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**
	Programme Elective-5 (Any One)	3-0-0	3				
STE301	Disaster Management and Mitigation						
STE302	Non-conventional Energy						
STE303	Project Planning and Management						
	Open Elective (Any One)	3-0-0	3				
	Business Analytics						
	Industrial Safety						
	Operations Research						
	Cost Management of Engineering Projects						
	Composite Materials						
	Waste to Energy						
	Internet of Things						
	Soft Computing						
	Project Engineering & Management						
	Start-up & Entrepreneurship Development						
	Total (Theory)	**6**	**6**		**Total (Theory)**	**0**	**0**
	Practical/ Sessional				**Practical/ Sessional**		
STJ301	Dissertation Phase-I	0-0-20	10	STJ401	Dissertation Phase-II	0-0-32	16
Total (Practical/ Sessional)		**20**	**10**	**Total (Practical/ Sessional)**		**32**	**16**
TOTAL		**26**	**16**	**TOTAL**		**32**	**16**
TOTAL SEMESTER CREDITS: 16				TOTAL SEMESTER CREDITS: 16			
TOTAL CUMULATIVE CREDITS: 52				TOTAL CUMULATIVE CREDITS: 68			

List of Audit courses

1	AHM101	English for Research Paper Writing
2	ACE101	Disaster Management
3	AHM102	Sanskrit for Technical Knowledge
4	AHM103	Value Education
5	AHM104	Constitution of India
6	AHM105	Pedagogy Studies
7	AHM106	Stress Management by Yoga
8	AHM107	Personality Development through Life Enlightenment Skills

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BRANCH: CIVIL ENGINEERING (2018-19 Admission Batch)

1st Semester

STC101	Theory of Elasticity and Plasticity	3-0-0	Credits 3

MODULE-I

Linear elasticity; stress, strain, constitutive relations, strain displacement relations, Equilibrium and compatibility equations, stress and displacement functions, Two dimensional problems in Cartesian and polar coordinates. Description of an elasticity problem as a boundary value problem, bending of beams- cantilever and simply supported beam, stress distribution for axisymmetric problems, pure bending of curved bars, effect of circular holes on stress distributions in plates. Aries stress function.

MODULE-II

Stress and strain in three dimensions: Principal stresses, maximum shearing stress, principal axes of strain. Stretching of prismatic bar by its own axis. Elementary problems of elasticity in three dimensions.

MODULE-III

Torsion of non-circular prismatic bars. Saint Venant's theory. Various analogies. Torsion of hollow and th section. Application of energy methods.

MODULE-IV

Introduction to the theory of plasticity. The yield criteria of metals, stress space representation of yield criter Stress-strain relations plastic potential, flow rules and maximum work hypothesis.

Two dimensional plastic flow problems. Incompressible two dimensional flow, stresses in plastic materials in condition of plane strain, equation of equilibrium the simplest slip-line fields.

Text/Reference Books:

1. S P Timoshenko and J N Goodier, Theory of Elasticity, Mc Graw Hill
2. Computational Elasticity – M Ameen, Narosa Publishing House.
3. Advanced Mechanics of Solids – L S Srinath, Tata McGraw-Hill
4. Hoffman and Sachs, Theory of plasticity
5. W. Johnson and P B Meller, Plasticity of Mechanical Engineers
6. C.R. Calladine, 'Plasticity for Engineers', Ellis Herwood, Chichester, U.K., 1985
7. M. Kachanov, 'Theory of Plasticity', MIR Publication.

STC102	Finite Element Analysis and its Applications	3-0-0	Credits 3

MODULE-I

Introduction: The Continuum, Equations of Equilibrium, Boundary Conditions, Strain displacement relations, Stress strain Relations, Plane stress and plane Strain problems, Basics of finite element method(FEM), different steps involved in FEM, Different approaches of FEM, Direct stiffness method, Energy approach, Weighted residual Method.

MODULE-II

One and Two Dimensional Problems: Detail formulation including shape functions. Stress - strain relations, strain displacement relations and derivation of stiffness matrices using energy approach, assembling of element matrices, boundary conditions, Numerical solution of one dimensional problems using spring, bar, truss, beam elements and frames. Derivation of shape function using Lagrange's interpolation, Pascal's triangle, Convergence criteria. Finite Element modeling of two dimensional problems using Constant strain Triangle (CST) elements, Stress strain relations for isotropic and orthotropic materials, four noded rectangular elements, and axisymmetric solids subjected to axisymmetric loading.

MODULE-III

Iso-parametric Elements: Natural coordinates, iso-parametric elements, four node, and eight node elements. Numerical integration, order of integration.

MODULE-IV

Plate Bending: Bending of plates, triangular elements, rectangular elements, and quadrilateral elements.

Text/Reference Books:

1. C. S. Krishnamoorthy, Finite Element analysis-Theory and Programming, Tata Mc Hill.
2. R. D. Cook., Concepts and Applications of Finite Element Analysis, Wiley.
3. O. C Zienkiewicz .and R. L. Taylor, Finite Element Method, Mc Graw Hill
4. C.S. Desai and J.F. Abel, Introduction to the Finite Element Method: CBS Publishers

STE101	Advanced Steel Structures	3-0-0	Credits 3

MODULE-I

Properties of steel: mechanical properties, hysteresis, ductility; Hot-Rolled Sections: compactness and non-compactness, slenderness, residual stresses.

MODULE-II

Inelastic bending – curvature, plastic moments, design criteria - stability, strength, drift; Stability criteria: stability of beams - local buckling of compression flange & web, lateral-torsional buckling.

MODULE-III

Stability of columns - slenderness ratio of columns, local buckling of flanges and web, bracing of column about weak axis, load and resistance factor design; Strength Criteria: beams – flexure, shear, torsion, columns - moment magnification factor, effective length, P-M interaction, biaxial bending, joint panel zones; Drift criteria: P-Δ effect.

MODULE-IV

Deformation-based design; Connections: types – welded, bolted, location – beam column, Column-Foundation, splices. Design of industrial trusses and frames.

Text/Reference Books:

1. N Subramanian, 'Design of steel structures', Oxford University Press
2. M Bill Wong, 'Plastic analysis and design of steel structures',
3. M Bruneau, CM Uang and SER Sabelli, 'Ductile design of steel structures'

STE102	Structural Dynamics	3-0-0	Credits 3

MODULE-I

Single degree of freedom system: Equation of motion, Damped and undamped free vibration, Response to harmonic, periodic, impulse load and general dynamic load, Duhamel's integral;

MODULE-II

Multi-degrees of freedom system: Equation of motion, Free vibration analysis, Dynamic response and modal analysis.

MODULE-III

Free and Forced vibration of distributed mass system: Longitudinal, flexural and torsional vibration of rods,

transverse vibration of beams. Raleigh's principle.

MODULE-IV

Analysis of structural response to Earthquakes: Seismological background, Deterministic analysis of Earthquake. Introduction to Random Vibration.

Text/Reference Books:

1. W.T. Thomson, "Theory of Vibration with Applications"
2. R.W. Clough & J. Penzien, "Dynamics of Structures", McGraw Hill
3. Dynamics of Structures: Theory and Applications to Earthquake Engineering, AKChopra, Prentice Hall of India
4. Structural Dynamics by S SRao
5. Structural Dynamics - Theory and Computation, M. Paz, Van Nostrand, 1985.
6. Structural Dynamics, M Mukhopadhyay: Anne Books Pvt Ltd, New Delhi

STE103	Prestressed Concrete	3-0-0	Credits 3

MODULE-I

Prestressing system, materials and codes: Basic concept, Losses of prestress, analysis of prestress and bending stresses. Need for high strength steel and concrete. Advantages and applications. Pre-tensioning and post tensioning systems

MODULE-II

Design of beams: Analysis and design of section for bending and shear, pressure line, concept of load balancing, cracking moment, bending of cables, limit state analysis and design, anchorage zone stresses, design of end block, Application to bridges.

MODULE-III

Selection of prestress concrete members, short term and long term deflections of uncracked members.

MODULE-IV

Flexural strength of prestressed concrete sections. Continuous beams, Design concept concordancy of cables, Secondary design consideration. Designpre-tensioned and post tensioned beam

Text/Reference Books:

1. Prestressed Concrete, Raju, N.K., Tata McGraw Hill
2. Prestressed Concrete, T. Y. Lin

STE104	Advanced Numerical Methods	3-0-0	Credits 3

MODULE-I

Introduction to digital computers & Programming: Errors - polynomial approximations and interpolations - Numerical differentiation & Integration;

MODULE-II

Evaluation of single and multiple integrals, Newton' smethod, variational and weight end residual methods., Matrices – Linear equations, Eigenvalues and Eigenvectors – nonlinear equations, different methods of solution of eigen value problems

MODULE-III

Harmonic and biharmonic equations**:** solutions, convergence, completeness & stability.

MODULE-IV

Initial and boundary value problems of finite difference method, Implicit & Explicit scheme.

.

Text/Reference Books:

1. Jain M. K, SRK Iyenge and RK Jain. "Numerical Methods for Scientific &Engg.Computation".
2. Mathews J. H "Numerical Methods for Mathematics, Science andEngineering".
3. Gerld C.F and PO Wheatley "Applied Numerical Analysis".
4. Gupta S.C and V. K. Kapoor "Fundamentals of Applied Statistic", Sultan Chand&Sons.
5. Johnson R.A "Probability and Statistics forEngineers.
6. Rajeshwaran S, "Numerical Methods in Science & Engineering (APracticalApproach)", Willey Publication.

STE105	Repair & Rehabilitation of Structures	3-0-0	Credits 3

MODULE-I

Maintenance and Repair Strategies-Maintenance, Repair and Rehabilitation, Facets of Maintenance, importance of Maintenance, Various aspects of Inspection, Assessment procedure for evaluating a damaged structure, causes of deterioration

MODULE-II

Strength and Durability of Concrete- Quality assurance for concrete –Strength, Durability and Thermal properties, of concrete; Cracks, different types, causes –Effects due to climate, temperature, Sustained elevated temperature, Corrosion – Effects of cover thickness.

MODULE-III

Protection Methods- Non-destructive Testing Techniques, Epoxy injection, Shoring, Underpinning, Corrosion protection techniques – Corrosion inhibitors, Corrosion resistant steels, Coatings to reinforcement, cathodic protection.

MODULE-IV

Techniques for Repair

Repair, Rehabilitation and Retrofitting of Structures- Evaluation of root causes; Underpinning & shoring; some simple systems of rehabilitation of structures; Guniting, shotcreting; Non-Destructive testing systems; Use of external plates, carbon fibre wrapping and carbon composites in repairs. Strengthening of Structural elements, Repair of structures distressed due to corrosion, fire, Leakage, earthquake.

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Text/Reference Books:

1. Repair and Rehabilitation of Concrete Structures by Poonam I. moii, Chirag N. patel.
2. Testing of Concrete in Structure by Bungey (Surrey University Press)
3. Non Destructive Testing by Malhotra&Carino (CRC Press)
4. Corrosion of Steel in Concrete by Broomfield John P. (Taylor & Francis)

STE106	Elastic Stability & Behavior of Metal Structures	3-0-0	Credits 3

MODULE-I

Introduction Fundamental principles and models for elastic stability. Stability/ elastic buckling of column

MODULE-II

Classification of dynamical systems, linear and nonlinear eigen value problems. The energy criterion and energy based methods of stability analysis. Stability of plates, frames, beams and arches.

MODULE-III

Lateral buckling of beams, combined bending and axial, combined bending and torsion. Buckling of thin elements. Torsional buckling of thin walled structures and open sections Column-strength curves. Buckling

and post-buckling strength of plates.

MODULE-IV

Introduction of dynamic stability of simply supported column.

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Text/Reference Books:

1. S P Timoshenko and J M Gere, 1963, Theory of elastic stability, McGraw Hill, London.
2. A Chajes, 1974, Principles of elastic stability, Prentice Hall, NJ.
3. G J Simitses, 1976, An introduction to the elastic stability of structures, Prentice Hall, NJ.
4. Z P Bazant and L Cedolin, 1990, Stability of structures, Oxford University Press, Oxford.
5. N G R Iyengar, 1986, Structural stability of columns and plates, Affiliated East-West Press, New Delhi.
6. D O Brush and B O Almoroth, 1975, Buckling of bars, plates and shells, McGraw Hill, NY.
7. T V Galambos, 1998, Guide to stability design criteria for metal structures, Wiley, NY
8. Stability Analysis and Design of Structures, New Delhi by Gambhir M.L

STC103	Advanced Concrete Lab – I	0-0-4	Credits 2

1. Workability test of concrete: Slump test, compaction factor test and flow table test
2. Cube Test of Concrete(Nominal Mix)
3. Cylinder Test for Concrete (Nominal Mix): Determination of axial stress, longitudinal strain, lateral strain and Poision's ratio. Plotting of stress-strain curve and determination of modulus of elasticity.
4. Split Tensile Strength Test of Concrete
5. Prism test for determining modulus of rupture of concrete
6. Design of Concrete Mix (As per Indian Standard Method)
7. Failure of RC beam in bending and shear (two point and one point loading)

STC104	Computational Lab-I	0-0-4	Credits 2

Computer programming in Excel Spread Sheet/C++/ Matlab / FORTRAN; Development of computer programs to solve problems related to civil engineering.

GHM101	Research Methodology & Intellectual Property Rights	2-0-0	Credits 2

MODULE-I **(06 Hours)**

Meaning of research problem, Sources of research problem, Criteria characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.

Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

MODULE-II **(04 Hours)**

Effective literature studies approaches, analysis,

Plagiarism, Research ethics.

MODULE-III **(04 Hours)**

Effective technical writing, how to write report, Paper.

Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

MODULE-IV **(06 Hours)**

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

MODULE-V **(04 Hours)**

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

MODULE-VI **(04 Hours)**

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Text/Reference Books:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science& engineering students".
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.

5. Mayall, “Industrial Design”, McGraw Hill, 1992.
6. Niebel, “Product Design”, McGraw Hill, 1974.
7. Asimov, “Introduction to Design”, Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “Intellectual Property in New Technological Age”, 2016.
9. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008

Course Outcomes: At the end of the course, students will be able to

1. Understand research problem formulation.
2. Analyze research related information
3. Follow research ethics
4. Understand that today’s world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property.

   Right to be promoted among students in general & engineering in particular.
6. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Audit Courses

AHM101	English for Research Paper Writing	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Understand that how to improve your writing skills and level of readability
2. Learn about what to write in each section
3. Understand the skills needed when writing a Title

   Ensure the good quality of paper at very first-time submission

MODULE-I **(4 Hours)**

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

MODULE-II **(4 Hours)**

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction.

MODULE-III **(4 Hours)**

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

MODULE-IV **(4 Hours)**

key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed whenwriting a Review of the Literature.

MODULE-V **(4 Hours)**

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions.

MODULE-VI **(4 Hours)**

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

Suggested Studies:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book.

4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

ACE101	Disaster Management	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

MODULE-I **(4 Hours)**

Introduction

Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

MODULE-II **(4 Hours)**

Repercussions of Disasters and Hazards:

Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem.

Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

MODULE-III **(4 Hours)**

Disaster Prone Areas in India

Study of Seismic Zones; Areas Prone To Floods And Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics

MODULE-IV **(4 Hours)**

Disaster Preparedness and Management

Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, Media Reports: Governmental and

Community Preparedness.

MODULE-V **(4 Hours)**

Risk Assessment

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategiesfor Survival.

MODULE-VI **(4 Hours)**

Disaster Mitigation

Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation In India.

Text / Reference Books:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies", New Royal book Company.
2. Sahni, Pardeep Et.Al. (Eds.)," Disaster Mitigation Experiences and Reflections", Prentice Hall of India, New Delhi.
3. Goel S. L., Disaster Administration and Management Text and Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi.

AHM102	Sanskrit for Technical Knowledge	2-0-0	Credits 0

Course Objectives:

1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. Learning of Sanskrit to improve brain functioning
3. Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power
4. The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature

MODULE-I **(8 Hours)**

- Alphabets in Sanskrit
- Past/Present/Future Tense
- Simple Sentences

MODULE-II **(8 Hours)**

- Order
- Introduction of roots
- Technical information about Sanskrit Literature

MODULE-III **(8 Hours)**

- Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

Suggested reading:

1. "Abhyaspustakam" – Dr. Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

Course Output: Students will be able to

1. Understanding basic Sanskrit language
2. Ancient Sanskrit literature about science & technology can be understood
3. Being a logical language will help to develop logic in students

AHM103	Value Education	2-0-0	Credits 0

Course Objectives: Students will be able to

1. Understand value of education and self- development
2. Imbibe good values in students
3. Know about the importance of character

MODULE-I **(6 Hours)**

- Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism.
- Moral and non- moral valuation. Standards and principles.
- Value judgements

MODULE-II **(6 Hours)**

- Importance of cultivation of values.
- Sense of duty. Devotion, Self-reliance.Confidence, Concentration. Truthfulness, Cleanliness.
- Honesty, Humanity.Power of faith, National Unity.
- Patriotism.Love for nature, Discipline

MODULE-III **(6 Hours)**

- Personality and Behavior Development - Soul and Scientific attitude.
- Positive Thinking. Integrity and discipline.
- Punctuality, Love and Kindness.
- Avoid fault Thinking.
- Free from anger, Dignity of labour.
- Universal brotherhood and religious tolerance.
- True friendship.
- Happiness Vs suffering, love for truth.
- Aware of self-destructive habits.
- Association and Cooperation.
- Doing best for saving nature

MODULE-IV **(6 Hours)**

- Character and Competence –Holy books vs Blind faith.
- Self-management and Good health.
- Science of reincarnation.
- Equality, Nonviolence, Humility, Role of Women.
- All religions and same message.
- Mind your Mind, Self-control.
- Honesty, Studying effectively

Text / Reference Books

1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

Course outcomes: Students will be able to

1. Knowledge of self-development

2. Learn the importance of Human values
3. Developing the overall personality

AHM104	Constitution of India	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutionalrole and entitlement to civil and economic rights as well as the emergence of nationhood inthe early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the BolshevikRevolution in 1917 and its impact on the initial drafting of the Indian Constitution.

MODULE-I **(4 Hours)**

- **History of Making of the Indian Constitution:**

  History

  Drafting Committee, (Composition& Working)

MODULE-II **(4 Hours)**

- **Philosophy of the Indian Constitution:**

  Preamble

  Salient Features

MODULE-III **(4 Hours)**

- **Contours of Constitutional Rights & Duties:**

  Fundamental Rights

  Right to Equality

  Right to Freedom

  Right against Exploitation

  Right to Freedom of Religion

  Cultural and Educational Rights

  Right to Constitutional Remedies

  Directive Principles of State Policy

Fundamental Duties.

MODULE-IV **(4 Hours)**

- **Organs of Governance:**

  Parliament

  Composition

  Qualifications and Disqualifications

  Powers and Functions

  Executive

  President

  Governor

  Council of Ministers

  Judiciary, Appointment and Transfer of Judges, Qualifications

  Powers and Functions

MODULE-V **(4 Hours)**

- **Local Administration:**

  District's Administration head: Role and Importance,

  Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation.

  Pachayati raj: Introduction, PRI: ZilaPachayat.

  Elected officials and their roles, CEO ZilaPachayat: Position and role.

  Block level: Organizational Hierarchy (Different departments),

  Village level: Role of Elected and Appointed officials,

  Importance of grass root democracy

  Model Curriculum of Engineering & Technology PG Courses [Volume -II]

MODULE-VI **(4 Hours)**

- **Election Commission:**

  Election Commission: Role and Functioning.

  Chief Election Commissioner and Election Commissioners.

  State Election Commission: Role and Functioning.

  Institute and Bodies for the welfare of SC/ST/OBC and women.

Text / Reference Books:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Outcomes: Students will be able to:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the passage of the Hindu Code Bill of 1956.

AHM105	Pedagogy Studies	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Review existing evidence on the review topic to inform programme design and policymaking undertaken by the DfID, other agencies and researchers.
2. Identify critical evidence gaps to guide the development.

MODULE-I **(4 Hours)**

- **Introduction and Methodology:**
- Aims and rationale, Policy background, Conceptual framework and terminology
- Theories of learning, Curriculum, Teacher education.
- Conceptual framework, Research questions**.**
- Overview of methodology and Searching.

MODULE-II **(2 Hours)**

- Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries.
- Curriculum, Teacher education.

MODULE-III **(4 Hours)**

- Evidence on the effectiveness of pedagogical practices
- Methodology for the in depth stage: quality assessment of included studies.
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?
- Theory of change.
- Strength and nature of the body of evidence for effective pedagogical practices.
- Pedagogic theory and pedagogical approaches.
- Teachers' attitudes and beliefs and Pedagogic strategies.

MODULE-IV **(4 Hours)**

- Professional development: alignment with classroom practices and follow up support
- Peer support
- Support from the head teacher and the community.
- Curriculum and assessment
- Barriers to learning: limited resources and large class sizes

MODULE-V **(2 Hours)**

- **Research gaps and future directions**
- Research design
- Contexts
- Pedagogy
- Teacher education
- Curriculum and assessment
- Dissemination and research impact.

Text / Reference Books:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2):245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal ofCurriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic

maths and reading in Africa: Does teacher preparation count? International JournalEducational Development, 33 (3): 272–282.

5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

Course outcomes: Students will be able to understand:

1. What pedagogical practices are being used by teachers in formal and informal classrooms indeveloping countries?
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, andwith what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

AHM106	Stress Management by Yoga	2-0-0	Credits 0

Course Objectives:

1. To achieve overall health of body and mind
2. To overcome stress

MODULE-I **(8 Hours)**

- Definitions of Eight parts of yoga. (Ashtanga)

MODULE-II **(8 Hours)**

- Yam and Niyam.

  Do`s and Don't's in life.

  i) Ahinsa, satya, astheya, bramhacharya and aparigraha

  ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

MODULE-III **(8 Hours)**

- Asan and Pranayam

i) Various yog poses and their benefits for mind & body

ii) Regularization of breathing techniques and its effects-Types of pranayam

Text / Reference Books:

1. 'Yogic Asanas for Group Tarining-Part-I": Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

Course outcomes: Students will be able to:

1. Develop healthy mind in a healthy body thus improving social health also
2. Improve efficiency

AHM107	Personality Development through Life Enlightenment Skills	2-0-0	Credits 0

Course Objectives:

1. To learn to achieve the highest goal happily
2. To become a person with stable mind, pleasing personality and determination
3. To awaken wisdom in students

MODULE-I **(8 Hours)**

Neetisatakam-Holistic development of personality

- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)
- Verses- 52,53,59 (dont's)
- Verses- 71,73,75,78 (do's)

MODULE-II **(8 Hours)**

Approach to day to day work and duties.

- Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48,
- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,
- Chapter 18-Verses 45, 46, 48.

MODULE-III **(8 Hours)**

Statements of basic knowledge.

- Shrimad Bhagwad Geeta: Chapter 2- Verses 56, 62, 68
- Chapter 12 - Verses 13, 14, 15, 16,17, 18
- Personality of Role model. Shrimad Bhagwad Geeta: Chapter 2- Verses 17, Chapter 3-Verses 36,37,42,
- Chapter 4- Verses 18, 38,39
- Chapter18 – Verses 37,38,63

Text / Reference Books:

1. "Srimad Bhagavad Gita" by Swami SwarupanandaAdvaita Ashram (PublicationDepartment), Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P. Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

Course outcomes: Students will be able to:

1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achievethe highest goal in life
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity
3. Study of Neetishatakam will help in developing versatile personality of students.

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

M.TECH SYLLABUS for *Specialization*: STRUCTURAL ENGINEERING

BRANCH: CIVIL ENGINEERING (2018-19 Admission Batch)

2nd Semester

STC201	Advanced Reinforced Concrete Design	3-0-0	Credits 3

MODULE-I

Estimation of crack width and deflection of reinforced concrete beams. Design of Pile-raft foundation, water tank and dome.

MODULE-II

Analysis and design of building frames subjected to wind load; Earthquake forces and structural response.

MODULE-III

Ductility of reinforced structures; material ductility-steel and concrete, section ductility, member ductility, structural ductility, ductile detailing of reinforced concrete frames for seismic forces.

MODULE-IV

Design of deep beams, Design of concrete shear walls.

Text/Reference Books:

1. R Park and T Paulay," Reinforced Concrete Structures", John Wiley & Sons
2. S. Pillai, D Menon, “Reinforced Concrete Design”
3. P.C. Varghese, "Advanced Reinforced Concrete Design", PHI, 2nd Edition, 2002
4. A.K. Jain, "Reinforced Concrete: Limit State Design", Nemchand and Bros, 1999
5. Ramakrishna &Arthur,"Ultimate strength design for structural concrete".

STC202	Theory of Plates & Shells	3-0-0	Credits 3

MODULE-I

Plates: Pure bending of plates, Slope and curvature of slightly bent plates, relationship between moment and curvature, strain energy in bending of plates

MODULE-II

Energy Differential equations for symmetrical bending of circular plates under lateral loads. Uniformly loaded, concentrically loaded and loaded at the center of simply supported and fixed circular plates. Differential equation of the deflection surface and boundary conditions of laterally loaded rectangular plates by classical theory, Solutions of simply supported rectangular plates due to sinusoidal loads, uniformly distributed loads and concentrated load by Navier's Solution, Levy approach.

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MODULE-III

Shells: Membrane theory and bending theory of symmetrical loaded shells of revolution, Spherical shells, conical shells, Membrane theory of cylindrical shells and shells of Double curvature such as Hyperbolic paraboloids and elliptic paraboloids, conoids.

MODULE-IV

Circular cylindrical shells loaded symmetrically with respect to its axis, particular cases of symmetrical deformation of circular cylindrical shells, cylindrical tanks of uniform wall thickness.

Text/Reference Books:

1. SP Timoshenko and SW Krieger, 'Theory of Plates and Shells'
2. OP Billington, Thin shell structures
3. E Ventsel and T Krauthammer, 'Thin Plates and Shells: Theory, Analysis & Applications', CRC, 1st edition, 2001
4. M.H Jawad, 'Theory and design of plate and shell structures', Kluwer Academic Publications
5. P.L. Gould, 'Analysis of shells and plates', Pearson Higher Education

STE201	Mechanics of Composite Materials	3-0-0	Credits 3

MODULE-1

Introduction: definition and characteristics, fibres, matrices, fibre reinforced composites, advantages and limitations, basic concepts and characteristics: isotropy, orthotropic, classification, methods of manufacturing composites, lamina and laminate, micromechanics and macro mechanics, constituent materials and properties,

rules of mixture, defects in composites

MODULE-II

Elastic behaviour of unidirectional lamina: specially orthotropic and transversely isotropic material, relati between mathematical and engineering constants, stress-strain relations for thin lamina, transformation of stre and strain, transformation of elastic parameters, transformation of stress-strain relations in terms of engineeri constants.

MODULE-III

Elastic behaviour of multidirectional laminates, symmetric and balanced laminates, cross ply and angle p laminates, design considerations, computational procedure for finding engineering elastic properties, stress a failure analysis of multidirectional laminates, theories of failure

MODULE-IV

Bending of laminated composite plates, thin laminated plate theory, deflection of all edges simply support rectangular symmetric cross-ply laminate, two opposite edges simply supported.

Text/Reference Books:

1. R. M. Jones, "Mechanics of composite materials"
2. Mukhopadhyay, "Mechanics of composite materials and structures"
3. I.M. Daniel & O. Ishai, "Engineering Mechanics of Composite Materials", Oxford Press
4. S.W. Tsai &H.T. Hahn, "Introduction to Composite Materials", Techonomic Pub.Co.INC, USA.
5. P.K. Sinha, "A short term course on Composite Materials and Structures"-1996

STE202	Bridge Engineering	3-0-0	Credits 3

MODULE-1

Introduction and selection of type of bridges, longitudinal arrangement and economical span, bridge components, Design preliminaries: Layout, types of loads including wind and seismic loads, standard specifications for road bridges, substructures, superstructures, IRC provisions on loads and stresses, specification for single/double multi - lane railway and road bridges, Abutments, piers and their foundations .

MODULE-II

Design of reinforced concrete slab culvert, box Culvert Bridge.

MODULE-III

Tee beam and slab bridge deck, design of prestressed concrete bridge.

MODULE-IV

Design of balanced cantilever bridge, design of continuous bridge, Introduction to long span bridges.

Text/Reference Books:

1. N.K. Raju, “Design of bridges", Oxford & IBH Publishing Co. pvt.ltd.
2. D. J. Victor," Essentials of bridge engineering", Oxford & IBH Publishing Co. pvt.Ltd.
3. Indian Road Congress Codes No.5, 6,18,21,24, Jamnagar House, Shah Jahan Road, New Delhi.

STE203	Earthquake Resistance Design of Structures	3-0-0	Credits 3

MODULE-I

Earthquake response of structures; Response spectrum, analysis, Spectral analysis; lateral load calculation, base shear.

MODULE-II

Seismology, Characteristics of earthquakes; Earthquake intensity and magnitude; Recording instruments and base line correction; seismicrisk and hazard, Predominant period and amplification through soil; Soil dynamics and seismic inputs to structures, Characterization ofground motion.

MODULE-III

Idealization of structural systems for low, medium and high rise buildings; Nonlinear and Push over analysis.

MODULE-IV

Concept of earthquake resistant design; Code provisions of analysis and design of buildings (IS 1893-13920); Reinforcement detailing for members and joints.

Text/Reference Books:

1. Clough R.W. and Penzien J., 'Dynamics of Structures', McGraw-Hill, 2nd edition, 1992
2. Earthquake Resistant Design: Shrikhandee&Agarwal-PHI Publication
3. Newmark N.M. and Rosenblueth E., 'Fundamentals of Earthquake Engg.', Prentice Hall,1971.
4. David Key, 'Earthquake Design Practice for Buildings', Thomas Telford, London, 1988.

5. Wiegel R.L., 'Earthquake Engg.', Prentice Hall, 1970.
6. Blume J.A., Newmark N.M., Corning L.H., 'Design of Multi-storied Buildings for Earthquakeground motions', Portland Cement Association, Chicago, 1961.
7. Proc. World Conferences on Earthquake Engg., 1956-1992.
8. I.S. Codes No. 1893, 4326, 13920 etc.

STE204	Advanced Construction Materials	3-0-0	Credits 3

MODULE-I

Fresh concrete and its rheology. Mechanical, deformational behaviour and microstructure of hardened concrete. Creep and shrinkage. Testing of concrete. Mix design and properties of concrete; High strength concrete; High density and light weight concretes; admixtures.

MODULE-II

Industrial waste materials in concrete, their influence on physical and mechanical properties and durability of concrete, Concreting under extreme weather conditions, High performance concrete, Vacuum concrete, Self-compacting concrete, Geopolymer concrete, Reactive powder concrete, Concrete made with industrial wastes. Changes in concrete with time, Corrosion of concrete in various environments. Corrosion of reinforcing steel. Ferro-cement, material and properties

MODULE-III

Foams and lightweight materials, fibre reinforced concrete. Types of fibres, workability, mechanical and physical properties of fibre reinforced concrete. Polymers in Civil Engineering, Polymers, fibres and composites.

MODULE-IV

Fibre reinforced plastic in sandwich panels, Modelling. Architectural use and aesthetics of composites. Adhesives and sealants. Structural elastomeric bearings and resilient seating. Moisture barriers, Polymer foams and polymers in Building, Polymer concrete composites.

Text/Reference Books:

1. Neville A.M., 'Properties of concrete', 3rd ed., 1985, ELBS Lea F.M.,
2. 'Chemistry of cement and concrete', 3rd ed., 1970, Edward Arnold Proceedings of recent seminars etc. and journals.
3. P. K. Mehta, “Concrete: Microstructure, Properties and Materials”

STE205	Optimization Methods & its Application in Civil Engineering	3-0-0	Credits 3

MODULE-I

Introduction: Need for engineering optimal design, Optimum design formulation: Design variable, objective function and constraints; unconstrained optimization methods Single variable optimization methods: Region elimination method – Golden Section search, Interval halving method; Gradient based method – Newton-Raphson, bisection and secant method.

MODULE-II

Multi variable optimization methods: Direct search method: Hooke-Jeeves pattern search, simplex reflection search, Powell's conjugate direction search. Gradient Based methods: Cauchy's steeped descent, Newton's method, Levenberg Marquardt's method, Fletcher- Reeve method; constrained optimization methods Kuhn Tucker condition, Penalty function method, Augmented Lagrangian method, sequential unconstrained minimization, cutting plane method.

MODULE-III

Introduction to Evolutionary algorithms: Need for evolutionary algorithms, Type of evolutionary methods, Introduction to Genetic algorithm (GA), Difference and similarities between GA and traditional methods. Basic operations of GA: reproduction, crossover, mutation and elitism. Binary coded and real coded GA.

MODULE-IV

Application of Optimization techniques in planning and management, Multi-objective optimization models.

Text/Reference Books:

1. J.S. Arora, Introduction to Optimum Design, Elsevier, 2nd Edition, 2004.
2. K. Deb, Optimization for Engineering. Design: Algorithms & Examples, Prentice Hall India, 2006
3. S.S. Rao, Engineering Optimization: Theory & Practice, New Age International (P) Ltd, 3rd Edition, 1996, Reprint: June, 2008
4. K. Deb, Multi-Objective Optimization Using Evolutionary Algorithms, John Wiley, 2003

STE206	Tall Structures	3-0-0	Credits 3

MODULE-I

Structural systems and concepts. Matrix and approximate methods, analysis of tall building frames, lateral load analysis, multi bay frames, gravity loads, settlement of foundation.

MODULE-II

Foundation-superstructure interaction. Earthquake effects and design for ductility. Analysis of shear walls - plane shear walls, in filled frames, coupled frames, frames with hear walls.

MODULE-III

Principle of three dimensional analysis of tall buildings; Perforated cores, pure torsion in thin tubes, bending and warping of perforated cores.

MODULE-IV

Analysis of floor system in tall buildings, Vierendal girders, dia grid floors, elastic stability of frames and shear walls. Analysis of thermal stresses.

Text/Reference Books:

1. Tall buildings - B. S. Taranath:
2. Handbook of Concrete Structures - Mark Fintel
3. Tall buildings - Coull and Smith
4. Design of Multi-storeyed structures - U. H. Variani
5. Tall Chimneys: Design & Construction - S. N. Manohar
6. Transmission Line Structures - Santhakumar& Murthy
7. IS:6533 (Part 2) –Code of Practice for Design and Construction of Steel Chimney
8. IS:4998 (Part 1)- Criteria for Design of Reinforced Concrete Chimneys

STC203	Advanced Concrete Lab – II	0-0-4	Credits 2

1. Mix design of concrete of different grades & using admixtures
2. Tensile and Flexural strength of concrete of different grades
3. Tensile strength of different types of steel rebars, rolled steel sections
4. Testing of simply supported RCC beams for flexural failure
5. Testing of simply supported RCC beams for shear failure
6. Testing of RCC column
7. Non-destructive testing of concrete including rebound hammer and ultrasonic pulse method
8. Permeability of concrete.

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

M.TECH SYLLABUS for *Specialization*: STRUCTURAL ENGINEERING

BRANCH: CIVIL ENGINEERING (2018-19 Admission Batch)

3rd Semester

STE301	Disaster Management and Mitigation	3-0-0	Credits 3

MODULE-I

Introduction: Concepts and definitions: Disaster, hazard, vulnerability, resilience, risks, frequency and details, capacity, impact, prevention, mitigation.

MODULE-II

Disasters: Disasters classification; natural disasters (floods, draught, cyclones, volcanoes, earthquakes, tsunami, landslides, coastal erosion, soil erosion, forest fires etc.); manmade disasters (industrial pollution, artificial flooding in urban areas, nuclear radiation, transportation accidents, terrorist strikes, etc.); hazard and vulnerability profile of India, mountain and coastal areas, ecological fragility. Disaster Impacts: Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability, etc. Dos and Don'ts during various types of Disasters.

MODULE-III

Disaster Risk Reduction (DRR): Disaster management cycle – its phases; prevention, mitigation, preparedness, relief and recovery; structural and non-structural measures; risk analysis, vulnerability and capacity assessment. Emerging approaches in Disaster Management - Three stages: Pre-disaster stage (preparedness), Emergency stage and Post Disaster stage – Rehabilitation. Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR programmes in India and the activities of National Disaster Management Authority.

MODULE-IV

Disasters, Environment and Development: Factors affecting vulnerability such as impact of developmental projects and environmental modifications (including of dams, land use changes, urbanization etc.), sustainable and environmental friendly recovery; reconstruction and development methods. Disaster management: Applications and case studies - Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

Text/Reference Books:

1. Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill IndiaEducationPvt. Ltd., 2012.
2. PradeepSahni, "Disaster Mitigation: Experiences and Reflections", Prentice Hall, 2004.

3. Singhal J.P. “Disaster Management”, Laxmi Publications, 2010.
4. Donald Hyndman & David Hyndman, “Natural Hazards & Disasters”, CengageLearning, 2010.
5. Singh B.K., Handbook of Disaster Management: Techniques & Guidelines, RajatPublication, 2008.
6. Govt. of India: Disaster Management Act, Government of India, New Delhi, 2005.

STE302	Non-conventional Energy	3-0-0	Credits 3

MODULE-I

Introduction various non-conventional energy resources- Introduction, availability, classification, relative merits and demerits. 3 Solar Cells: Theory of solar cells. Solar cell materials, solar cell array, solar cell power plant, limitations.

MODULE-II

Solar Thermal Energy: Solar radiation, flat plate collectors and their materials, applications and performance, focussing of collectors and their materials, applications and performance; solar thermal power plants, thermal energy storage for solar heating and cooling, limitations.

MODULE-III

Geothermal Energy: Resources of geothermal energy, thermodynamics of geothermal energy conversion-electrical conversion, non-electrical conversion, environmental considerations. 4 Magneto-hydrodynamics (MHD): Principle of working of MHD Power plant, performance and limitations. 2 Fuel Cells: Principle of working of various types of fuel cells and their working, performance and limitations.

MODULE-IV

Thermo-electrical and thermionic Conversions: Principle of working, performance and limitations. 2 Wind Energy: Wind power and its sources, site selection, criterion, momentum theory, classification of rotors, concentrations and augments, wind characteristics. Performance and limitations of energy conversion systems. Bio-mass: Availability of bio-mass and its conversion theory. 2 Ocean Thermal Energy Conversion (OTEC): Availability, theory and working principle, performance and limitations. Wave and Tidal Wave: Principle of working, performance and limitations. Waste Recycling Plants.

Text/Reference Books:

1. Raja etal, “Introduction to Non-Conventional Energy Resources” Scitech Publications.
2. John Twideu and Tony Weir, “Renewal Energy Resources” BSP Publications, 2006.
3. M.V.R. Koteswara Rao, “Energy Resources: Conventional & Non-Conventional “BSP Publications,

2006.

4. D.S. Chauhan, “Non-conventional Energy Resources” New Age International. 5.
5. C.S. Solanki, “Renewal Energy Technologies: A Practical Guide for Beginners” PHI Learning

STE303	Project Planning and Management	3-0-0	Credits 3

MODULE-I

Introduction: Definition, Objective, functions and scope of construction management; Resources for Construction, Types of Construction, stages in construction, scientific methods of management; construction team. Construction Contracts and Specifications: Types of construction contracts; contract documents; specifications; general and special conditions of contract; contract management; arbitration and settlement. Construction Planning: Construction Planning methodology, Stages of planning: - Pre-tenderplanning; contract planning; planning and scheduling construction jobs by bar charts; Limitations of Bar Charts. Preparation of Man, Machine, Material and Money schedule.

MODULE-II

Network Techniques In Construction Management: Necessity of Network Technique in Construction planning and Management.Types of Network technique. Difference between PERT & amp; CPM. Elements of Network: -Event, Activity, Dummy. Network Rules, Methods ofNumbering the Events. Work Breakdown Structure.PERT- Time Computations: - earliest Expected Time (T E), Latest Allowable OccurrenceTime (T L). Combined Tabular computations for T E and T L. PERT-Network Analysis: - Slak, Criticalpath.CPM-Network Analysis: Activity Expected Time (T E), Latest Allowable Occurrence Time (T L). Combined Tabular computations for T E and T L. Float, Critical activity and critical path. Allocation of resources. Computer software for network analysis. Time Cost Optimization: Direct cost, indirect cost, total cost; purpose, stages andmethods of cost control techniques of time cost optimization; examples and casestudies.

MODULE-III

Site Lay-Out: Principles governing site lay out; factors affecting site lay out; preparation ofsite lay out. Supervision, Inspection and Quality Control: Supervisor & #39; s responsibilities; keeping records; control of field activities handling disputes and work stoppages; storage and protection of construction materials and equipment; testing and qualitycontrol. Purpose of inspection: Inspection of various components of construction; reports and records; statistical quality control. Safety in Construction: Safety: importance of safety, accident-prone situations atconstruction site i.e, safety measures for excavation, drilling/ blasting, scaffolding/ formwork, hoisting & erection demolition and hot bituminous work. FireSafety: Safety record of construction industry, safety campaign.

MODULE-IV

Labour Laws and Acts: Wages of construction Labours, Trade unions connected with theConstruction Industries, Trade union Act-1926. Labour Welfare Fund Act-1965, Payment of Wages Act, Minimum Wage Act-1948, Contract Labour act. Project Management: Feasibility study; project reports; progress reports;

monitoring and controlling project activities.

Text/Reference Books:

1. Challahan, M.T., Construction Project Scheduling.
2. Srinath, L.S. PERT and CPM-Concepts and Applications.
3. Austen: Managing Construction Projects, A guide to Processes & Procedures International Labour office, Geneva
4. Douglas and Manager: Construction Management, Prentice Hall

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

M.TECH SYLLABUS for *Specialization*: COMPUTER SCIENCE & ENGINEERING

BRANCH: COMPUTER SCIENCE & ENGINEERING (2018-19 Admission Batch)

First Semester				Second Semester			
Theory				**Theory**			
Course Code	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**	**Course Code**	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**
	Programme Core-1	3-0-0	3		**Programme Core-3**	3-0-0	3
CSC101	Advance Data Structure & Algorithms			CSC201	Advance Compiler Design		
	Programme Core-2	3-0-0	3		**Programme Core-4**	3-0-0	3
CSC102	Advance Computer Architecture			CSC202	Cryptography & Network Security		
	Programme Elective-1 (Any One)	3-0-0	3		**Programme Elective-3 (Any One)**	3-0-0	3
CSE101	Computational Methods & Techniques			CSE201	Data Mining and Data Warehousing		
CSE102	Machine Learning			CSE202	Distributed Database		
CSE103	Computational Intelligence			CSE203	Data Analytics		
	Programme Elective-2 (Any One)	3-0-0	3		**Programme Elective-4 (Any One)**	3-0-0	3
CSE104	Advance Operating System			CSE204	Crowd Sensing		
CSE105	Advance Real-time Systems			CSE205	Cloud Computing & Big Data		
CSE106	Distributed Operating System			CSE206	Wireless Sensor Networks		
GHM101	Research Methodology & Intellectual Property Rights	2-0-0	2		**Audit Course-2 (Any One from the list of Audit Courses)**	2-0-0	0
	Audit Course-1 (Any One from the list of Audit Courses)	2-0-0	0				
	Total (Theory)	**16**	**14**		**Total (Theory)**	**14**	**12**
	Practical/ Sessional				**Practical/ Sessional**		
	Lab-1	0-0-4	2		**Lab-3**	0-0-4	2
CSC103	Advance Computing Lab			CSC203	Technical Report Writing		
	Lab-2	0-0-4	2		**Lab-4**	0-0-4	2
CSJ101	Pre-thesis work & Seminar-1			CSJ201	Pre-thesis work & Seminar-2		
				CSJ202	**Mini Project with Seminar**	0-0-4	2
	Total (Practical/ Sessional)	**8**	**4**		**Total (Practical/ Sessional)**	**12**	**6**
	TOTAL	**24**	**18**		**TOTAL**	**26**	**18**
TOTAL SEMESTER CREDITS: 18				TOTAL SEMESTER CREDITS: 18			
TOTAL CUMULATIVE CREDITS: 18				TOTAL CUMULATIVE CREDITS: 36			

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

M.TECH SYLLABUS for *Specialization*: COMPUTER SCIENCE & ENGINEERING

BRANCH: COMPUTER SCIENCE & ENGINEERING (2018-19 Admission Batch)

Third Semester				Fourth Semester			
Theory				**Theory**			
Course Code	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**	**Course Code**	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**
	Programme Elective-5 (Any One)	3-0-0	3				
CSE301	Advance Software Engineering						
CSE302	Speech Processing						
CSE303	Image Processing & Pattern Recognition						
	Open Elective (Any One)	3-0-0	3				
	Business Analytics						
	Industrial Safety						
	Operations Research						
	Cost Management of Engineering Projects						
	Composite Materials						
	Waste to Energy						
	Internet of Things						
	Soft Computing						
	Project Engineering &Management						
	Start-up & Entrepreneurship Development						
	Total (Theory)	**6**	**6**		**Total (Theory)**	**0**	**0**
	Practical/ Sessional				**Practical/ Sessional**		
CSJ301	Dissertation Phase-I	0-0-20	10	CSJ401	Dissertation Phase-II	0-0-32	16
	Total (Practical/ Sessional)	**20**	**10**		**Total (Practical/ Sessional)**	**32**	**16**
	TOTAL	**26**	**16**		**TOTAL**	**32**	**16**
TOTAL SEMESTER CREDITS: 16				TOTAL SEMESTER CREDITS: 16			
TOTAL CUMULATIVE CREDITS: 52				TOTAL CUMULATIVE CREDITS: 68			

List of Audit courses

1	AHM101	English for Research Paper Writing
2	ACE101	Disaster Management
3	AHM102	Sanskrit for Technical Knowledge
4	AHM103	Value Education
5	AHM104	Constitution of India
6	AHM105	Pedagogy Studies
7	AHM106	Stress Management by Yoga
8	AHM107	Personality Development through Life Enlightenment Skills

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

M.TECH SYLLABUS for *Specialization*: COMPUTER SCIENCE & ENGINEERING

BRANCH: COMPUTER SCIENCE & ENGINEERING (2018-19 Admission Batch)

1st Semester

CSC101	Advance Data Structure & Algorithms	3-0-0	Credits 3

Course Objective

Student should be able to

- Define algorithm formally and informally
- Explain elementary and advanced data structures
- Explain the different algorithms for solving typical problems
- Describe the process of algorithm design and analysis
- Explain the complexity of algorithms
- Design recursive and non-recursive algorithms for, say, computing a Fibonacci number
- Explain P, NP and NP-completeness

MODULE-I **(12 Hours)**

Introduction: Role of Algorithms in Computing, Analyzing Algorithms, Designing Algorithms, Asymptotic Notation, Standard Notations and Functions. Advance data structure linear vs non linear data structure.

Hashing: Review of Hashing, Hash Function, Collision Resolution Techniques in Hashing, Separate Chaining, Open Addressing, Linear Probing, Quadratic Probing, Double Hashing, Rehashing, extendible Hashing.

MODULE-II **(12 Hours)**

Heap Structure: Min-Max heap, Leftist heaps, Binomial heaps, Fibonacci heaps.

Search and Multimedia Structure: Binary Search Tree, AVL Tree, 2-3 Tree, B-Tree, B+ Tree, Red-Black Tree, Splay tree.

MODULE-III **(16 Hours)**

Divide and Conquer (Quick sort and Merge sort, Strassen's algorithm for Matrix Multiplication)

Dynamic Programming (LCS, Floyd-Warshall Algorithm, Chain Matrix Multiplication)

Greedy Algorithm (Single Source Shortest Path, Knapsack problem, Minimum Cost Spanning Trees)

Geometric Algorithm (Convex hulls, Segment Intersections, Closest Pair)

Internet Algorithm (Tries, Ukonnen's Algorithm, Text pattern matching, data compression, The Huffman coding algorithm)

Numerical Algorithm (Integer, Matrix and Polynomial multiplication, Extended Euclid's algorithm)

Backtracking – n-Queens problem Hamiltonian Circuit Problem – Subset Sum Problem-Branch and Bound.

MODULE-IV **(8 Hours)**

Polynomial Time, Polynomial-Time Verification, NP Completeness & reducibility, NP Completeness proofs, Cook's theorem

Text Book

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", 3rd Edition, PHI Learning Private Limited, 2012.

Reference Book

1. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", 3rd Edition, Addison-Wesley Longman, 2011.
2. E. Horowitz, S. Sahani and Dinesh Mehta, "Fundamentals of Data Structures in C++", 2nd Ed, University Press.
3. Mark Allen Weiss, "Data Structures & Algorithm Analysis in C/C++", Pearson Edu. India.
4. Adam Drozdex, "Data Structures and algorithms in C++", Thomason learning.
5. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "Data Structures andAlgorithms", Pearson Education, Reprint 2006.

Course Outcomes

- CO1- Graduate will be able to evaluate and analysis complexity of the algorithm.
- CO2- Graduate will be able to understand divide and conquer technique of the algorithm.
- CO3- Graduate will be able to understand Dynamic and Greedy programming in algorithm design.
- CO4- Graduate will be able to understand Internet and Backtracking can be used in algorithm
- CO5- Graduate will be able to adopt best algorithm design techniques to solve the given problems.

CSC102	Advance Computer Architecture	3-0-0	Credits 3

Course objective:

The objective of this course is to analyze the parallelism, identify the conditions of parallelism, and study different parallel interconnection systems. It also focuses on identifying the pipeline hazards, gain in-depth knowledge of architecture and learn parallel processing and its applications to solve workloads.

MODULE-I **(10 Hours)**

Flynn's classification: SISD, SIMD, MISD, MIMD, Parallel Processing: Definition, Theory of Parallelism. Parallel Computer Models, Parallelism in Uni-processor computers, Implicit Parallelism vs. explicit parallelism, Levels of parallelism. Software Parallelism, Hardware Parallelism, Amdahl's law, Overview of RISC and CISC architecture, System Performance attributes of parallel Computers.

MODULE-II **(10 Hours)**

Pipelining: Linear pipe line processor, Asynchronous and Synchronous models, speed up, Efficiency, Throughput, Pipelining in MIPS architecture, Non linear pipe line processor, Instruction pipeline, Arithmetic pipeline. Conditions of Parallelism: Data and Resource Dependencies, Control Dependence, Resource dependence, Bernstein's condition, Hardware and software parallelism, pipeline hazards and their Resolution Mechanisms like data forwarding, Delayed Branch, Branch Prediction, Dynamic Branch Prediction(Two state machine, four state machine), loop unrolling, dynamic scheduling, Software pipelining.

MODULE-III **(10 Hours)**

Loosely coupled and tightly coupled system, Parallel Interconnection Systems: Static and Dynamic Networks, Linear Array, Ring, Star, Tree, Mesh, Systolic Array, Chordal ring, Completely connected network, Cube connected cycles, Torus, K-ary-n cube, Barrel shifter, single stage interconnection network, Multistage Interconnection Networks, Control Structure, Node degree, diameter, Bisection width, symmetric, functionality, Network Latency, Bandwidth, Scalability, Data routing functions:- Permutation, Perfect shuffle exchange, Hypercube Routing function.

MODULE-IV **(10 Hours)**

Memory hierarchy, Cache Design Issues, Memory Interleaving, Introduction to multicores, grid and cluster, Case studies on some commercial processors like Pentium, Power PC etc.

Text Books:

1. Computer Architecture - A quantitative approach By J.L Hennessy and D.A.Patterson, Morgan Kaufmann
2. Advanced Computer Architecture, by Kai Hwang, Naresh Jotwani, Mc Graw Hill - Edu.

Reference Books:

1. Introduction to Parallel Computing, 2nd Edition, Pearson Education by Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar.

Course outcome:

1. Analyze the parallelism.
2. Identify the conditions of parallelism.
3. Study different parallel interconnection systems.
4. Identify the pipeline hazards.
5. Gain in-depth knowledge of architecture.
6. Learn parallel processing and its applications to solve workloads.
7. Understanding pipelined and non-pipelined processing.

CSE101	Computational Methods & Techniques	3-0-0	Credits 3

Course Objective:

1. Understand mathematical models of lower level engineering problems.
2. Learn how to solve nonlinear equations numerically
3. Solving simultaneous linear equations numerically.

MODULE-I:

Neural Networks: Artificial Neural Network and Introduction, Learning Rules, Knowledge Representation and Acquisition, Different Methods of Learning.

Algorithms of Neural Network: Feed-forward Error Back Propagation, Hopfield Model, Kohonen's Featrure, Map, K-Means Clustering, ART Networks, RBFN, Application of Neural Network to the relevant field.

MODULE-II

Fuzzy Logic: Basic Concepts of Fuzzy Logic, Fuzzy vs Crisp Set, Linguistic variables, Membership Functions, Operations of Fuzzy Sets, Fuzzy If-Then Rules, Variable Inference Techniques, Defuzzification, Basic Fuzzy, Inference Algorithm, Fuzzy System Design, FKBC and PID Control, Antilock Breaking System (ABS), Industrial Applications.

MODULE-III

Optimization Fundamentals: Definition, Classification of Optimization Problems, Unconstrained and Constrained Optimization, Optimality Conditions.

Linear Programming: Simplex Method, Duality, Sensitivity Methods

Non-Linear Programming: Newton's Method, GRG Method, Penalty Function Method, Augmented Langrange Multiplier Method, Dynamic Programming and Integer Programming, Interior Point Methods, Karmakar's Algorithm, Dual Affine, Primal Affine.

MODULE-IV

Genetic Algorithm: GA and Genetic Engineering, Finite Element based Optimization, PSO, BFO, Hybridization of Optimization Technique, Application of Optimization Technique for Solving Projects (Project solutions). Implementation of Branch Relevant Industrial Applications by Matlab Code.

Books Recommended:

1. Neural Networks- by Simon Haykin
2. Fuzzy Logic with Engineering Application- by ROSS J.T (Tata Mc)
3. Neural Networks and Fuzzy Logic – by Bart Kosko

4. An introduction Fuzzy Control – by D. Driankor, H. Hellendorn, M. Reinfrank (Narosa Pub) IEEE Press
5. Ashok D. Begundu & chandrapatla T.R "Optimization concept and application in engineering", Prentice Hall,1999
6. Rao S.S "Engineering Optimization"
7. Optimization Research; Prabhakar Pai, Oxford University Press.

Course Outcomes:

Students will be able to know the concept and steps of problem solving, mathematical modeling, solution and implementation Knowledge and understanding of the ability to use, mathematical techniques.

CSE102	Machine Learning	3-0-0	Credits 3

MODULE-I **(10 Hours)**

Introduction: Basic definitions, types of learning, hypothesis space and inductive bias, evaluation, cross-validation. Linear regression, Decision trees, over fitting

.

MODULE-II **(10 Hours)**

Instance based learning, Feature reduction, Collaborative filtering based recommendation. Probability and Bayes learning

.

MODULE-III **(10 Hours)**

Logistic Regression, Support Vector Machine, Kernel function and Kernel SVM.

Neural network: Perceptron, multilayer network, back propagation, introduction to deep neural network.

MODULE-IV **(10 Hours)**

Computational learning theory, PAC learning model, Sample complexity, VC Dimension, Ensemble learning.

Clustering: k-means, adaptive hierarchical clustering, Gaussian mixture model

BOOKS:

1. Machine Learning. Tom Mitchell. First Edition, McGraw-Hill, 1997.
2. Introduction to Machine Learning Edition 2, by EthemAlpaydin

CSE103	Computational Intelligence	3-0-0	Credits 3

MODULE-I **(4 Hours)**

Introduction to Soft Computing: Soft computing constituents and conventional Artificial Intelligence, Neuro-Fuzzy and Soft Computing characteristics.

MODULE-II **(12 Hours)**

Fuzzy Sets: Introduction, Basic definitions and terminology, Set-theoretic operations, MF Formulation and parameterization, More on fuzzy union, intersection, and complement.

Fuzzy Rules and Fuzzy Reasoning: Extension principle and fuzzy relations, Fuzzy If-Then rules, Fuzzy reasoning. Fuzzy Inference Systems: Mamdani fuzzy models, Sugeno Fuzzy Models, Tsukamoto fuzzy models, other considerations.

MODULE-III **(8 Hours)**

Derivative-free optimization: Genetic algorithm, simulated annealing, random search, Downhill simplex search.

MODULE-IV **(16 Hours)**

Adaptive Networks:

Architecture, Back propagation for feed forward networks, Extended back propagation for recurrent networks, Hybrid learning rule.

Supervised learning neural networks: Perceptions, Adaline, Back propagation multi layer perceptions, Radial Basis Function Networks, Modular network.

Learning from reinforcement: Introduction.

Unsupervised learning and other neural networks: Competitive learning networks, Kohonen self-organizing networks, learning vector Quantization, Hebbian learning, principal component networks, and The Hopfield network.

MODULE-V **(8 Hours)**

Adaptive Neuro-Fuzzy Inference Systems: ANFIS architecture, Hybrid learning algorithms, Learning methods that cross-fertilize ANFIS and RBNF, Simulation examples.

Book(s):

1. Neuro Fuzzy and Soft Computing by J.S.R. Jang, C.T. Sun, E. Mizutani, PHI.
2. Neural Network Design by Martin T Hagan, H B Demuth, M Beale, CENGAGE Learning, India Edition.

3. Neural Networks and Learning Machines by Simon Haykin, PHI.
4. Genetic Algorithms in search, Optimization and Machine Learning, 1st Edition by David E. Goldberg, PEARSON.

CSE104	Advance Operating System	3-0-0	Credits 3

Course Objective:

This course is designed to examine the fundamental principles of distributed systems, and provide students hands-on experience in developing distributed protocols. While we still look at issues in distributed operating systems, this course will address distributed systems in a broader sense.

MODULE-I **(10 Hours)**

Introduction to parallel Computing, Solving problems in parallel, Structures of parallel computers, Instruction level parallel processing, Parallel Algorithms, Parallel programming, Operating Systems for parallel computers, Performance Evaluation of parallel computers.

MODULE-II **(10 Hours)**

Characterization of distributed systems, Design goals, Communication and computer networks, Distributed processing, Distributed operating systems, Client Server Communications.

MODULE-III **(10 Hours)**

Remote Procedure calls, File Service, Name Service, Distributed transactions and concurrency control, fault tolerance and security.

MODULE-IV **(10 Hours)**

Synchronization & Coordination, Distributed Algorithms, research issues. Special topics in distributed operating systems.

Text Books:

1. M. Singhal & N. G. Shivaratri, Advanced Concepts in Operating Systems, McGraw Hill-Education.
2. G. Coulororis, J. Dollimore & T. Kindberg, Distributed Systems: Concepts and Design, Addison-Wesley

Reference Books:

1. W. Buchanan, Distributed Systems and Networks, Tata McGraw Hill

2. H. F. Jordan, Fundamentals of Parallel Processing, Pearson.
3. P. S. Pacheco, Parallel Programming with MPI, Morgan Kaufmann
4. P. K. Sinha, Distributed Operating Systems, IEEE Press
5. C. Hughes & T, Hughes, Parallel and Distributed Programming Using C++, Pearson.

Course Outcome:

1. Examine the fundamental principles of distributed systems
2. Provide students hands-on experience in developing distributed protocols.
3. Understanding issues in distributed operating systems.

CSE105	Advance Real-time Systems	3-0-0	Credits 3

Course Description

1. To introduce students to the fundamental problems, concepts, and approaches in the design and analysis of real-time systems.
2. To study issues related to the design and analysis of systems with real-time constraints. The problem of ensuring such constraints is ultimately a scheduling problem.

Prerequisites

Students are required to be comfortable with computational-complexity issues pertaining to validating timing constraints. Some basic knowledge of NP-completeness, as covered in undergraduate or graduate algorithms classes, will be useful. Students should have a decent background in algorithms and operating systems.

Objectives

Student Learning Objectives/Outcomes:

1. Real-time scheduling and schedulability analysis {a,b,c}
2. Formal specification and verification of timing constraints and properties {a,b,c,d}
3. Design methods for real-time systems {a,b,c}
4. Development and implementation of new techniques to advance the state-of-the-art real-time systems research {c, d, e, f}

MODULE-I

Introduction

Digital control, High-level controls, Signal processing, Real time applications

Hard versus Soft Real-Time Systems

Jobs and processors, Release times, Deadlines, and timing constraints, Hard and soft timing constraints, Hard real-time systems, Soft real-time systems,

Reference Model of Real-Time Systems

Processor and resources, Temporal parameters of real-time workload, Periodic task model, Precedence constraints and data dependency, Other dependencies, Functional parameters, Resource parameters of jobs and parameters of resources, Scheduling hierarchy

Approaches to Real-Time Scheduling

Clock-driven approach, Weighted round-robin approach, Priority-driven approach, Dynamic versus static system, Effective release times and deadlines, Optimality of the EDF and LST algorithms, Nonoptimality of the EDF and LST algorithms, Challenges in validating timing constraints in priority-driven systems, Off-line versus on-line scheduling,

MODULE-II

Clock-Driven Scheduling

Notations and assumptions, Static, Timer-driven scheduler, General structure of cyclic schedules, Cyclic executives, Improving the average response time of aperiodic jobs, Scheduling sporadic jobs, Practical considerations and generalization, Algorithm for constructing static schedules, Pros and cons of clock-driven scheduling

Priority-Driven Scheduling of Periodic Tasks

Static assumption, Fixed-priority versus dynamic-priority algorithms, Maximum schedule utilization, Optimality of the RM and DM algorithms, A schedulability test for fixed-priority tasks with short response times, schedulability test for fixed-priority tasks with arbitrary response times, Sufficient schedulability conditions for the RM and DM algorithms, Practical factor

Scheduling Aperiodic and Sporadic Jobs in Priority-Driven Systems

Assumptions and approaches, Deferrable servers, Sporadic servers, Constant utilization, total bandwidth, and weighted fair-queuing servers, Slack stealing in deadline-driven systems, Slack stealing in fixed-priority systems, Scheduling of sporadic jobs, Real-time performance for jobs, with soft timing constraints, Low-level scheme for integrated scheduling.

MODULE-III

Resources and Resource Access Control

Assumptions on resources and their usage, Effects of resources contention and resource access control, Nonpreemptive critical sections, Basic priority-inheritance protocol, Basic priority-ceiling protocol, Stack-based, priority-ceiling (ceilingpriority) protocol, Use of priority-ceiling protocol in dynamic-priority system, Preemption-ceiling protocol, Controlling accesses to multiple-unit resources,Controlling concurrent accesses to data objects.

MODULE-IV

Multiprocessor Scheduling, Resource Access Control and Synchronization

Model of multiprocessor and distributed systems, Task assignment, Multiprocessor priority-ceiling protocol,

Elements of scheduling algorithms for end-end periodic tasks, End-to-end tasks in heterogeneous systems, Predictability and validation of dynamic multiprocessor systems.

Real –Time Communication

Model of real-time communication, Priority-based service disciplines for switched networks, Weighted round-robin service disciplines, Medium access-control protocols of broadcast networks, Internet and resource reservation protocols, Realtime protocol, Communication in multi computer systems.

Text Book:

1. Jane W.S. Liu, "Real-Time Systems", Prentice Hall, USA, 2000.

Reference

1. Rajib Mall, "Real-Time Systems Theory and Practice", Pearson Education, India, 2007.
2. C. Siva Ram Murthy and G. Manimaran, "Resource Management in Real-Time Systems and Networks", Prentice-Hall of India, 2005.

Course Outcomes

1. An ability to understand advanced concepts in theory of computer science;
2. An ability to understand advanced concepts in applications of computer science;
3. An ability to apply knowledge of advanced computer science to formulate the analyse problems in computing and solve them;
4. An ability to learn emerging concepts in theory and applications of computer science;
5. An ability to design and conduct experiments as well as to analyze and interpret data; and
6. An ability to function in teams and to communicate effectively.

CSE106	Distributed Operating System	3-0-0	Credits 3

MODULE-I

Introduction to Distributed Systems, What is a Distributed System? Hard ware concepts, Software concepts, Design issues. Communication in Distributed Systems, Lay red Protocols, ATM networks.

MODULE-II

The Client – server model, Remote Procedure call, Group communication. Synchronization in Distributed System, Clock Synchronization, Mutual Exclusion, Election algorithms, Atomic transactions, Deadlocks in Distributed Systems. Process and processors in Distributed System threads, System Models, Processors allocation, Scheduling in Distributed System, Fault tolerance.

MODULE-III

Real time Distributed System. Distributed File Systems, Distributed File System Design, Distributed File

System implementation, Trends in Distributed File System. Distributed Shared Memory, Introduction, What is Shared memory?

MODULE-IV

Consistency models, Page based Distributed Shared memory, Shared – variable Distributed Shared memory, Object based Distributed Shared Memory.

Text Books:

1. Distributed Operating Systems, Andrew S. Tanenbanm

Reference Book:

1. Advanced Concepts in Operating Systems, Makes Singhal and Niranjan G. Shivaratna.

CSC103	Advance Computing Lab	0-0-4	Credits 2

Prerequisites:

Knowledge of C/C++/Java and Unix Programming is essential.

MODULE-I: Experiments on Advance Operating System (10 Experiments)

1. Execution of various file/directory handling commands.
2. To study the various commands operated in vi editor in LINUX
3. To study the various File Acess Permission and different types users in LINUX
4. a. Write a shell script program to find the Maximum three numbers.
   b. Write a shell script program for comparison of strings
   c. Perform Arithmetic operation using CASE
5. a. Calculate the factorial value of a number using shell script .
   b. To write a shell program to generate fibonacci series.
   c. Write a program to draw a Pascal's Triangle
6. a. Write a program to demonstrate a one-way pipe between two Processes.
   b. Write a program to illustrate IPC through pipe and fork system calls – Printing only odd numbers.
7. a. To write a program to create a process in LINUX.
   b. To study Dinning Philosophers Problem.
8. Simulation of scheduling algorithms: Write a program to implement the following process scheduling algorithms
   a. First Come First Serve

b. Shortest Remaining Job First

c. Round Robin

9.. Write a program To simulate banker's algorithm for deadlock avoidance

10. i. Page replacement algorithm for FIFO.

ii. Page replacement algorithm for LFU.

iii. Page replacement algorithm for LRU.

MODULE-II: Experiments on Advance Computer Architecture (10 experiments)

1. Performance evaluation. Amdahl's law.
2. Instruction set measurements.
3. Pipelined design.
4. Instruction pipeline design.
5. Programming pipelined computers.
6. Increasing ILP with compilation techniques.
7. Dynamic scheduling: Tomasulo's algorithm.
8. Speculation.
9. Vector computer programming.
10. Multicomputer programming.

MODULE-III: Experiments on Advance Data Structure and Algorithms (10 experiments using C/C++/JAVA)

1. Write programs to implement the de-queue (double ended queue) ADT usinga doubly linked list and an array.
2. Write programs that use non-recursive functions to traverse the given binary tree in a) Preorder b) inorder and c) postorder.
3. Write programs for the implementation of bfs and dfs for a given graph.
4. Write programs for implementing the following sorting methods: a) Merge sort b) Heap sort
5. Write programs to perform the following operations:
   a) Insertion into a B-tree b) Deletion from a B-tree
6. Write programs to perform the following operations:
   a) Insertion into an AVL-tree b) Deletion from an AVL-tree
7. Write programs to implement Kruskal's algorithm to generate a minimum cost spanning tree.
8. Write program to implement Prim's algorithm to generate a minimum cost spanning tree.
9. Write a program to implement all the functions of a dictionary (ADT) using hashing.
10. Write programs to calculate various time and space complexities of algorithms.

CSJ101	Pre-thesis work & Seminar - 1	0-0-4	Credits 2
In preparation of the thesis, students will be taught on how to develop a research proposal and how to do literature review, outlining all aspects of the planned work. The student has to present his / her research proposal and the proposal will be discussed in research seminar. In order to select or work on any research area for the M. Tech thesis, the student has to consult his / her assigned supervisor (s). The proposal must be approved by the supervisor (s) and head of the department before the thesis work to be undertaken			

GHM101	Research Methodology & Intellectual Property Rights	2-0-0	Credits 2

MODULE-I **(06 Hours)**

Meaning of research problem, Sources of research problem, Criteria characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.

Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

MODULE-II **(04 Hours)**

Effective literature studies approaches, analysis,

Plagiarism, Research ethics.

MODULE-III **(04 Hours)**

Effective technical writing, how to write report, Paper.

Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

MODULE-IV **(06 Hours)**

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

MODULE-V **(04 Hours)**

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

MODULE-VI **(04 Hours)**

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Text/Reference Books:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science& engineering students'".
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.
5. Mayall, "Industrial Design", McGraw Hill, 1992.
6. Niebel, "Product Design", McGraw Hill, 1974.
7. Asimov, "Introduction to Design", Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016.
9. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

Course Outcomes: At the end of the course, students will be able to

1. Understand research problem formulation.
2. Analyze research related information
3. Follow research ethics
4. Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property.

   Right to be promoted among students in general & engineering in particular.
6. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Audit Courses

AHM101	English for Research Paper Writing	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Understand that how to improve your writing skills and level of readability
2. Learn about what to write in each section
3. Understand the skills needed when writing a Title

   Ensure the good quality of paper at very first-time submission

MODULE-I **(4 Hours)**

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

MODULE-II **(4 Hours)**

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction.

MODULE-III **(4 Hours)**

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

MODULE-IV **(4 Hours)**

key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed whenwriting a Review of the Literature.

MODULE-V **(4 Hours)**

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions.

MODULE-VI **(4 Hours)**

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

Suggested Studies:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book.
4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

ACE101	Disaster Management	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

MODULE-I **(4 Hours)**

Introduction

Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

MODULE-II **(4 Hours)**

Repercussions of Disasters and Hazards:

Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem.

Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

MODULE-III **(4 Hours)**

Disaster Prone Areas In India

Study of Seismic Zones; Areas Prone To Floods And Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics

MODULE-IV **(4 Hours)**

Disaster Preparedness and Management

Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data From Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness.

MODULE-V **(4 Hours)**

Risk Assessment

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategiesfor Survival.

MODULE-VI **(4 Hours)**

Disaster Mitigation

Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation In India.

Text / Reference Books:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies, NewRoyal book Company.
2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences and Reflections", Prentice Hall OfIndia, New Delhi.
3. Goel S. L., Disaster Administration and Management Text and Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi.

AHM102	Sanskrit for Technical Knowledge	2-0-0	Credits 0

Course Objectives:

1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. Learning of Sanskrit to improve brain functioning
3. Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power
4. The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from

ancient literature

MODULE-I **(8 Hours)**

- Alphabets in Sanskrit
- Past/Present/Future Tense
- Simple Sentences

MODULE-II **(8 Hours)**

- Order
- Introduction of roots
- Technical information about Sanskrit Literature

MODULE-III **(8 Hours)**

- Technical concepts of Engineering-Electrical, Mechanical,Architecture, Mathematics

Suggested reading:

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

Course Output: Students will be able to

1. Understanding basic Sanskrit language
2. Ancient Sanskrit literature about science & technology can be understood
3. Being a logical language will help to develop logic in students

AHM103	Value Education	2-0-0	Credits 0

Course Objectives: Students will be able to

1. Understand value of education and self- development
2. Imbibe good values in students
3. Know about the importance of character

MODULE-I **(6 Hours)**

- Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism.
- Moral and non- moral valuation. Standards and principles.
- Value judgements

MODULE-II **(6 Hours)**

- Importance of cultivation of values.
- Sense of duty.Devotion, Self-reliance.Confidence, Concentration. Truthfulness, Cleanliness.
- Honesty, Humanity.Power of faith, National Unity.
- Patriotism.Love for nature, Discipline

MODULE-III **(6 Hours)**

- Personality and Behavior Development - Soul and Scientific attitude.
- Positive Thinking. Integrity and discipline.
- Punctuality, Love and Kindness.
- Avoid fault Thinking.
- Free from anger, Dignity of labour.
- Universal brotherhood and religious tolerance.
- True friendship.
- Happiness Vs suffering, love for truth.
- Aware of self-destructive habits.
- Association and Cooperation.
- Doing best for saving nature

MODULE-IV **(6 Hours)**

- Character and Competence –Holy books vs Blind faith.
- Self-management and Good health.
- Science of reincarnation.
- Equality, Nonviolence, Humility, Role of Women.
- All religions and same message.
- Mind your Mind, Self-control.
- Honesty, Studying effectively

Text / Reference Books

1. Chakroborty, S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi

Course outcomes: Students will be able to

1. Knowledge of self-development
2. Learn the importance of Human values
3. Developing the overall personality

AHM104	Constitution of India	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutionalrole and entitlement to civil and economic rights as well as the emergence of nationhood inthe early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the BolshevikRevolution in 1917 and its impact on the initial drafting of the Indian Constitution.

MODULE-I **(4 Hours)**

- **History of Making of the Indian Constitution:**

  History

  Drafting Committee, (Composition& Working)

MODULE-II **(4 Hours)**

- **Philosophy of the Indian Constitution:**

  Preamble

  Salient Features

MODULE-III **(4 Hours)**

- **Contours of Constitutional Rights & Duties:**

  Fundamental Rights

  Right to Equality

Right to Freedom
Right against Exploitation
Right to Freedom of Religion
Cultural and Educational Rights
Right to Constitutional Remedies
Directive Principles of State Policy
Fundamental Duties.

MODULE-IV **(4 Hours)**

- **Organs of Governance:**

Parliament
Composition
Qualifications and Disqualifications
Powers and Functions
Executive
President
Governor
Council of Ministers
Judiciary, Appointment and Transfer of Judges, Qualifications
Powers and Functions

MODULE-V **(4 Hours)**

- **Local Administration:**

District's Administration head: Role and Importance,
Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation.
Pachayati raj: Introduction, PRI: ZilaPachayat.
Elected officials and their roles, CEO ZilaPachayat: Position and role.
Block level: Organizational Hierarchy (Different departments),
Village level: Role of Elected and Appointed officials,
Importance of grass root democracy
Model Curriculum of Engineering & Technology PG Courses [Volume -II]

MODULE-VI **(4 Hours)**

- **Election Commission:**

Election Commission: Role and Functioning.

Chief Election Commissioner and Election Commissioners.

State Election Commission: Role and Functioning.

Institute and Bodies for the welfare of SC/ST/OBC and women.

Text / Reference Books:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Outcomes: Students will be able to:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the passage of the Hindu Code Bill of 1956.

AHM105	Pedagogy Studies	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Review existing evidence on the review topic to inform programme design and policymaking undertaken by the DfID, other agencies and researchers.
2. Identify critical evidence gaps to guide the development.

MODULE-I **(4 Hours)**

- **Introduction and Methodology:**

- Aims and rationale, Policy background, Conceptual framework and terminology
- Theories of learning, Curriculum, Teacher education.
- Conceptual framework, Research questions**.**
- Overview of methodology and Searching.

MODULE-II **(2 Hours)**

- Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries.
- Curriculum, Teacher education.

MODULE-III **(4 Hours)**

- Evidence on the effectiveness of pedagogical practices
- Methodology for the in depth stage: quality assessment of included studies.
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?
- Theory of change.
- Strength and nature of the body of evidence for effective pedagogical practices.
- Pedagogic theory and pedagogical approaches.
- Teachers' attitudes and beliefs and Pedagogic strategies.

MODULE-IV **(4 Hours)**

- Professional development: alignment with classroom practices and follow up support
- Peer support
- Support from the head teacher and the community.
- Curriculum and assessment
- Barriers to learning: limited resources and large class sizes

MODULE-V **(2 Hours)**

- **Research gaps and future directions**
- Research design
- Contexts
- Pedagogy
- Teacher education
- Curriculum and assessment
- Dissemination and research impact.

Text / Reference Books:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2):245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum

Studies, 36 (3): 361-379.

3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International JournalEducational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

Course outcomes: Students will be able to understand:

1. What pedagogical practices are being used by teachers in formal and informal classrooms indeveloping countries?
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, andwith what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

AHM106	Stress Management by Yoga	2-0-0	Credits 0

Course Objectives:

1. To achieve overall health of body and mind
2. To overcome stress

MODULE-I **(8 Hours)**

- Definitions of Eight parts of yoga. (Ashtanga)

MODULE-II **(8 Hours)**

- Yam and Niyam.

  Do`s and Don't's in life.

  i) Ahinsa, satya, astheya, bramhacharya and aparigraha

  ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

MODULE-III **(8 Hours)**

- Asan and Pranayam
  i) Various yog poses and their benefits for mind & body
  ii) Regularization of breathing techniques and its effects-Types of pranayam

Text / Reference Books:

1. 'Yogic Asanas for Group Tarining-Part-I" :Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

Course outcomes: Students will be able to:

1. Develop healthy mind in a healthy body thus improving social health also
2. Improve efficiency

AHM107	Personality Development through Life Enlightenment Skills	2-0-0	Credits 0

Course Objectives:

1. To learn to achieve the highest goal happily
2. To become a person with stable mind, pleasing personality and determination
3. To awaken wisdom in students

MODULE-I **(8 Hours)**

Neetisatakam-Holistic development of personality

- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)
- Verses- 52,53,59 (dont's)
- Verses- 71,73,75,78 (do's)

MODULE-II **(8 Hours)**

Approach to day to day work and duties.

- Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48,
- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,

- Chapter 18-Verses 45, 46, 48.

MODULE-III **(8 Hours)**

Statements of basic knowledge.

- Shrimad Bhagwad Geeta: Chapter 2- Verses 56, 62, 68
- Chapter 12 -Verses 13, 14, 15, 16,17, 18
- Personality of Role model. Shrimad Bhagwad Geeta: Chapter 2- Verses 17, Chapter 3-Verses 36,37,42,
- Chapter 4- Verses 18, 38,39
- Chapter18 – Verses 37,38,63

Text / Reference Books:

1. "Srimad Bhagavad Gita" by Swami SwarupanandaAdvaita Ashram (PublicationDepartment), Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

Course outcomes: Students will be able to:

1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achievethe highest goal in life
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity
3. Study of Neetishatakam will help in developing versatile personality of students.

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

M.TECH SYLLABUS for *Specialization*: COMPUTER SCIENCE & ENGINEERING

BRANCH: COMPUTER SCIENCE & ENGINEERING (2018-19 Admission Batch)

2nd Semester

CSC201	Advance Compiler Design	3-0-0	Credits 3

Course Objectives:

- The objectives of this course are to explore the principles, algorithms and data structures involved in the design and construction of compilers.
- To introduce the major concept areas of language translation and compiler design.
- To enrich the knowledge in various phases of compiler.
- To extend the knowledge of various parsing techniques such as LL and LR parsers.

Prerequisites: Knowledge of data structures, regular expressions, finite automata and context free grammar.

MODULE-I (Chapters: 1, 2, 3 and 4) (12 Hours)

Introduction to Compilers: Compilers and translators, the phases of a compiler, brief overview of all the phases of compiler, compiler writing tools, cousins of compiler, the Lexical and Syntactic structure of a language.

A simple one pass compilers: Overview, Syntax definition, parse tree, parsing (overview of top down and bottom up parsing) and syntax directed translation.

Lexical Analysis: The role of the lexical analyzer, Input buffering, specification of tokens and recognition of tokens, regular expressions finite automata,

Syntax Analysis: The role of Parser, Context free grammars, ambiguity and its elimination, elimination of left recursion, left factoring, Top-down parsing, bottom-up parsing, Operator-precedence parsing, LR Parsers (The Canonical Collection of LR (0) items, Constructing SLR, Canonical LR, and LALR parsing tables).

MODULE-II (Chapters: 5, 6 and 7) (10 Hours)

Syntax Directed Translation: Syntax directed definitions, construction of syntax tree, bottom-up evolution of S-attributed definitions, L-attributed definition, top-down translation, bottom-up evaluation of inherited attributed, recursive evaluators.

Type Checking: Type systems (Static and dynamic), type expression, Type Checking, Type Equivalence, Type Conversion.

Run time Environments: Storage organization, storage allocation, symbol tables, structure of Symbol Table, Simple Symbol Table (Linear Table, Ordered List, Tree, Hash Table), dynamic storage allocation techniques.

MODULE-III (Chapters: 8 and 9) (8 Hours)

Intermediate Code Generation: Intermediate Language, Intermediate representation Technique, Three-address

code, quadruples and triples, Translation of assignment statements, Boolean expressions, Control Flow, Case Statement, and Function, Back Patching and procedure call.

Issues in the design of code generation, target machine, run time storage management, Register Allocation and assignment, DAG representation, peephole optimization, Code generation using dynamic programming,

MODULE-IV (Chapter: 10) (8 Hours)

Code Optimization: Need of code optimization, Optimization of Basic Blocks, Loops in flow graph, global data flow analysis, Optimizing transformation (Compile time evaluation, common sub-expression elimination, Variable Propagation, Code Movement Optimization, Strength Reduction, Dead code optimization, Loop Optimization), Local Optimization, Global Optimization, Computing Global data flow equation, Setting up data flow Equations, Iterative Data Flow Analysis.

Error Detection and Recovery: Errors, Lexical- Phase errors, Syntactic- Phase errors, Semantic errors, Error handling routines

Text Book:

1. Compilers: Principles, Techniques, and Tools, Authors: Alfred V. Aho, Ravi Sethi and Jeffery D. Ullman (Pearson Education)

Reference Books:

1. Compiler Design by Santanu Chattopadhyay, PHI
2. The Theory and Practice of Compiler Writing: Jean-Paul Tremblay and Paul G. Sorenson

   (BS Publications)
3. Compiler Design: O G Kakde, University Science press
4. Advanced Compiler Design and Implementation, Steven Muchnic, Elsevier Publications

Course Outcomes:
After completion of this course, the following are the course out comes.

- To use the knowledge of patterns, tokens & regular expressions for solving the problems in the field of

computer science.

- To deal with different translators.
- To develop program to solve complex problems in compiler.
- To learn the new code optimization techniques to improve the performance of a program in terms of speed & space.
- To acquire the knowledge of modern compiler & its features.
- To learn & use the new tools and technologies used for designing a compiler
- To design & implement a software system for backend of the compiler.

CSC202	Cryptography & Network Security	3-0-0	Credits 3

Course Objective

The course is designed to provide students with a theoretical and practical knowledge of cryptography and network security. They shall have a strong understanding of different cryptographic protocols and techniques and be able to use them. The concept learned can be used to conduct research in the area of network security.

Detailed Syllabus: Theory

MODULE-I **(10 Hours)**

Introduction: Need for Security, Security Goals, Attacks, Security Services andMechanisms.

Mathematics for Cryptography: Integer Arithmetic, Modular Arithmetic, Matrices, Linear Congruence, Algebraic Structures - Groups, Rings, Fields and GF(2^n) Fields, Prime Numbers, Fermat's and Euler's Theorems, Primality Testing, Factorization, Chinese Remainder Theorem, Quadratic Congruence, Exponentiation, Logarithms.

MODULE-II **(10 Hours)**

Symmetric-Key Encipherment: Classical Symmetric-Key Ciphers, Substitution Ciphers, Transposition Ciphers, Block and Stream Ciphers, DES and its Analysis, AES and its Analysis.

Asymmetric-Key Encipherment: Principles of Public Key Cryptosystems, RSA Cryptosystem, Rabin Cryptosystem, ElGamal Cryptosystem, Elliptic Curve Cryptosystem

MODULE-III **(10 Hours)**

Message Integrity and Authentication: Message Digests, Random Oracle Model, MDC and MAC, Cryptographic Hash Functions, Digital Signatures - Process, Services, Techniques, Security Analysis, and Applications.

Entity Authentication: Passwords, Challenge-response, Zero-knowledge, Biometrics.

Key Management: Symmetric-key Distribution, Kerberos, Diffie-Hellman Key Agreement, Public-key Distribution.

MODULE-IV **(10 Hours)**

Application Layer Security: E-mail Security, PGP, S/MIME.

Transport Layer Security: Secure Socket Layer (SSL) and Transport Layer Security (TLS) Protocols.

Network Layer Security: IP Security (IPSec)

Text Book:

1. B. A. Forouzan, D. Mukhopadhyay, "Cryptography and Network Security.", McGraw Hill, 2nd ed.2010.

   (Module 1: Chapters 1-2, 4, 9, Module 2: Chapters 3, 5-8, 10, Module 3: Chapters 11-15, Module 4: Chapters 16-18)

Reference Books:

1. William Stallings, "Cryptography and Network Security", Pearson Education, 2006.
2. Eric Cole, Dr. Ronald Kurtz and James W. Conley, "Network Security Bible", Wiley Publishers, 2009

Course Outcomes

1. Understand cryptography and network security concepts and applications.
2. Learn different encryption techniques and apply them.
3. Understand the fundamental principles of message integrity, access control models and authentication techniques and learn the way of their application.
4. Understand the techniques of key management.
5. Identify and mitigate security vulnerabilities in communication protocols.

CSE201	Data Mining and Data Warehousing	3-0-0	Credits 3

- The objective of this course is to introduce data warehousing and mining techniques.
- Application of data mining in web mining, pattern matching and cluster analysis is included to aware students of broad data mining areas.

MODULE-I **(8 Hours)**

Introduction to Data Warehousing; Data Mining: Mining frequent patterns, association and correlations; Sequential Pattern Mining concepts, primitives, scalable methods.

MODULE-II **(10 Hours)**

Classification and prediction; Cluster Analysis – Types of Data in Cluster Analysis, Partitioning methods, Hierarchical Methods; Transactional Patterns and other temporal based frequent patterns, Mining Time series Data, Periodicity Analysis for time related sequence data, Trend analysis, Similarity search in Time-series analysis.

MODULE-III **(12 Hours)**

Mining Data Streams, Methodologies for stream data processing and stream data systems, Frequent pattern mining in stream data, Sequential Pattern Mining in Data Streams, Classification of dynamic data streams, Class Imbalance Problem, Graph Mining; Social Network Analysis.

MODULE-IV **(12 Hours)**

Web Mining, Mining the web page layout structure, mining web link structure, mining multimedia data on the web, Automatic classification of web documents and web usage mining; Distributed Data Mining, Recent trends in Distributed Warehousing and Data Mining, Class Imbalance Problem; Graph Mining; Social Network Analysis.

Text Book:

1. Alex Berson and Stephen J. Smith "Data Warehousing, Data Mining & OLAP", Tata McGraw – Hill Edition, Tenth Reprint 2007

References:

1. Jiawei Han, Micheline Kamber, and Jian Pei, "Data Mining Concepts and Techniques", Third Edition, Elsevier.
2. Reema Thareja, Data Warehousing, Oxford University Press.

Course Outcomes:

- Study of different sequential pattern algorithms
- Study the technique to extract patterns from time series data and it application in real world.
- Can extend the Graph mining algorithms to Web mining.
- Help in identifying the computing framework for Big Data.

CSE202	Distributed Database	3-0-0	Credits 3

COURSE OBJECTIVE

The objective of course is to provide insight to distributed database, normalization techniques and integrity rules. It also includes parallel database systems along with object-oriented models.

MODULE-I **(11 Hours)**

Introduction: Distributed Data processing, Distributed database system (DDBMS), Promises of DDBMSs, Complicating factors and Problem areas in DDBMSs, Overview Of Relational DBMS Relational Database concepts, Normalization, Integrity rules, Relational Data Languages, Relational DBMS.

MODULE-II **(9 Hours)**

Distributed DBMS Architecture: DBMS Standardization, Architectural models for Distributed DBMS, Distributed DBMS Architecture. Distributed Database Design: Alternative design Strategies, Distribution design issues, Fragmentation, Allocation. Semantic Data Control: View Management, Data security, Semantic Integrity Control.

MODULE-III **(10 Hours)**

Overview of Query Processing: Query processing problem, Objectives of Query Processing, Complexity of Relational Algebra operations, characterization of Query processors, Layers of Query Processing, Introduction to Transaction Management: Definition of Transaction, Properties of transaction, types of transaction. Distributed Concurrency Control: Serializability theory, Taxonomy of concurrency control mechanisms, locking bases concurrency control algorithms.

MODULE-IV **(12 Hours)**

Distributed Object Database Management systems: Fundamental Object concepts and Object models, Object distribution design. Architectural issues, Object management, Distributed object storage, Object query processing. Transaction management. Database Interoperability: Database Integration, Query processing, Parallel Database Systems: Database servers, Parallel architecture, Parallel DBMS techniques, Parallel execution problems, Parallel execution for hierarchical architecture. Recent approaches, models and current trends in improving the performance of Distributed Database.

Course Outcomes

Able to understand relational database management systems, normalization to make efficient retrieval from database and query.

Text Book:

1. Principles of Distributed Database Systems, Second Edition, M. Tamer Ozsu Patrick Valduriez

References:

1. Distributed Databases principles and systems, Stefano Ceri, Giuseppe Pelagatti, Tata McGraw Hill

CSE203	Data Analytics	3-0-0	Credits 3

Course Objective

The objective of course is to provide a wide range of data analytic techniques and is structured around the broad contours of the different types of data analytics, namely, descriptive, inferential, predictive, and prescriptive analytics.

MODULE-I **(8 Hours)**

Descriptive Statistics: Introduction to the course Descriptive Statistics, Probability Distributions, Inferential Statistics: Inferential Statistics through hypothesis tests Permutation & Randomization Test, Regression, and ANOVA (Analysis of Variance).

MODULE-II **(9 Hours)**

Machine Learning: Introduction and Concepts, Differentiating algorithmic and model based frameworks, Regression: Ordinary Least Squares, Ridge Regression, Lasso Regression, K-Nearest Neighbours Regression & Classification.

MODULE-III **(12 Hours)**

Supervised Learning with Regression and Classification techniques -1, Bias-Variance Dichotomy, Model Validation Approaches, Logistic Regression, Linear Discriminant Analysis, Quadratic Discriminant Analysis, Regression and Classification Trees, Support Vector Machines, Supervised Learning with Regression and Classification techniques -2, Ensemble Methods: Random Forest, Neural Networks, Deep learning.

MODULE-IV **(12 Hours)**

Unsupervised Learning and Challenges for Big Data Analytics, Clustering, Associative Rule Mining, Challenges for big data analytics, Prescriptive analytics: Creating data for analytics through designed experiments, Creating data for analytics through Active learning, Creating data for analytics through Reinforcement learning.

Text Books:

1. Hastie, Trevor, et al. The elements of statistical learning. Vol. 2. No. 1. New York: springer, 2009.

References:

1. Montgomery, Douglas C., and George C. Runger., Applied statistics and probability for engineers. John Wiley & Sons, 2010.

Course Outcome

Able to understand various data analytic techniques namely, descriptive, inferential, predictive, and prescriptive analytics.

CSE204	Crowd Sensing	3-0-0	Credits 3

Course Objective(s):

Students will understand the concepts of mobile crowdsensind and crowdsourcing and can able to build its applications.

MODULE-I

Introduction, Applications, Platform, evaluation of Sensing, mobile sensing, Crowdsourcing, Crowdsensing, Crowdmapping, Mobile Crowdsensing and crowdsourcing.

MODULE-II

Arcitecture and infrastructure of crowdsensing and crowdsourcing, Hierarchy of Classification, Type Of Crowdsensing, Participatory Crowdsensing, Distance Based Recruitment Mode (DBRM), Sociability Driven Recruitment Mode (SDRM), Opportunistic Crowdsensing,

MODULE-III

Process OfCrowdsensing And Mobile Crowdsensing, System and Platform, Any One Of The Domain Application On Crwodsensing. Policy, Energy Characterisation

MODULE-IV

Security Issues and Solutions, Incentive Mechanisms for Participants, Privacy and solutions, Protect Privacy: Anonymization, Secure Multiparty Computation, Data Perturbation, Future Directions.

Crowdsensingsim A Simulator, Architecture OfCrowdsensingsim.

Text Book:

1. CristianBorcea, ManoopTalasila, Reza Curtmola, "Mobile Crowdsensing", CRC Press. (Chapter 1-7)

Course Outcome(s):

On successful completion of the course, the student will:

- Understand the concepts of mobile crowdsensind and crowdsourcing
- Analyze basic protocols in mobile crowdsensind
- Design mobile crowdsensindapplications in different domain and be able to analyze their performance
- Implement basic mobile crowdsensindapplications on embedded platform

CSE205	Cloud Computing & Big Data	3-0-0	Credits 3

Course Objectives:

The student will learn about the cloud environment, building software systems and components that scale to millions of users in modern internet, cloud concepts capabilities across the various cloud service models including IAAS, PAAS, SAAS, and developing cloud-based software applications on top of cloud platforms.

Syllabus:

MODULE-I: Systems modeling, Clustering and virtualization:

Scalable Computing over the Internet, Technologies for Network based systems, System models for Distributed and Cloud Computing, Software environments for distributed systems and clouds, Performance, Security And Energy Efficiency

Implementation Levels of Virtualization, Virtualization Structures/ Tools and mechanisms, Virtualization of CPU, Memory and I/O Devices, Virtual Clusters and Resource Management, Virtualization for Data Center Automation.

MODULE-II: Cloud Platform Architecture:

Cloud Computing and service Models, Architectural Design of Compute and Storage Clouds, Public Cloud Platforms,

Inter Cloud Resource Management, Cloud Security and Trust Management. Service Oriented Architecture, Message Oriented Middleware.

Cloud Programming and Software Environments: Features of Cloud and Grid Platforms, Parallel & Distributed Programming Paradigms, Programming Support of Google App Engine, Programming on Amazon AWS and Microsoft Azure, Emerging Cloud Software Environments.

MODULE-III: Cloud Resource Management and Scheduling:

Policies and Mechanisms for Resource Management Applications of Control Theory to Task Scheduling on a Cloud, Stability of a Two Level Resource Allocation Architecture, Feedback Control Based on Dynamic Thresholds. Coordination of Specialized Autonomic Performance Managers, Resource Bundling, Scheduling Algorithms for Computing Clouds, Fair Queuing, Start Time Fair Queuing, Borrowed Virtual Time, Cloud Scheduling Subject to Deadlines, Scheduling MapReduce Applications Subject to Deadlines.

MODULE-IV:

Storage Systems: Evolution of storage technology, storage models, file systems and database, distributed file systems, general parallel file systems. Google file system., Apache Hadoop, BigTable, Megastore, Amazon Simple Storage Service(S3).

TEXT BOOKS:

1. Cloud Computing, A Hands-on approach, Arshadeep Bahga, Vijay Madisetti, University Press.

REFERNCE BOOK:

1. Cloud Computing, A Practical Approach, Anthony T Velte, Toby J Velte, Robert Elsenpeter, TMH
2. Mastering Cloud Computing, Foundations and Application Programming, Raj Kumar Buyya, Christen Vecctiola, S Tammarai Selvi, TMH
3. Distributed and Cloud Computing, Kai Hwang, Geoffry C. Fox, Jack J. Dongarra M K, Elsevier.
4. Cloud Computing, Theory and Practice, Dan C Marinescu, M K Elsevier.

Course Outcomes:

1. Understanding the key dimensions of the challenge of Cloud Computing
2. Assessment of the economics, financial, and technological implications for selecting cloud computing for own organization
3. Assessing the financial, technological, and organizational capacity of employer's for actively initiating and installing cloud-based applications.
4. Assessment of own organizations' needs for capacity building and training in cloud computing-related IT areas

CSE206	Wireless Sensor Networks	3-0-0	Credits 3

MODULE-I

Characteristics Of WSN: Characteristic requirements for WSN - Challenges for WSNs – WSN vs Adhoc Networks - Sensor node architecture – Commercially available sensor nodes –Imote, IRIS, Mica Mote, EYES nodes, BTnodes, TelosB, Sunspot -Physical layer and transceiver design considerations in WSNs, Energy usage profile, Choice of modulation scheme, Dynamic modulation scaling, Antenna considerations. Medium Access Control Protocols: Fundamentals of MAC protocols - Low duty cycle protocols and wakeup concepts - Contentionbased protocols - Schedule-based protocols - SMAC - BMAC - Traffic-adaptive medium access protocol (TRAMA) - The IEEE 802.15.4 MAC protocol.

MODULE-II

Routing And Data Gathering Protocols Routing Challenges and Design Issues in Wireless Sensor Networks, Flooding and gossiping – Data centric Routing – SPIN – Directed Diffusion – Energy aware routing - Gradient-based routing - Rumor Routing – COUGAR – ACQUIRE – Hierarchical Routing - LEACH, PEGASIS – Location Based Routing – GF, GAF, GEAR, GPSR – Real Time routing Protocols – TEEN, APTEEN, SPEED, RAP - Data aggregation - data aggregation operations - Aggregate Queries in Sensor Networks - Aggregation Techniques – TAG, Tiny DB.

MODULE-III

Embedded Operating Systems: Operating Systems for Wireless Sensor Networks – Introduction - Operating System Design Issues - Examples of Operating Systems – TinyOS – Mate – MagnetOS – MANTIS - OSPM -

EYES OS – SenOS – EMERALDS – PicOS – Introduction to Tiny OS – NesC – Interfaces and Modules-Configurations and Wiring - Generic Components -Programming in Tiny OS using NesC, Emulator TOSSIM.

MODULE-IV

Applications Of WSN: WSN Applications - Home Control - Building Automation - Industrial Automation - Medical Applications - Reconfigurable Sensor Networks - Highway Monitoring - Military Applications - Civil and Environmental Engineering Applications - Wildfire Instrumentation - Habitat Monitoring - Nanoscopic Sensor Applications – Case Study: IEEE 802.15.4 LR-WPANs Standard - Target detection and tracking - Contour/edge detection - Field sampling.

TEXT BOOKS

1. KazemSohraby, Daniel Minoli and TaiebZnati, "Wireless Sensor Networks Technology, Protocols, and Applications", John Wiley & Sons, 2007.
2. Holger Karl and Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley & Sons, Ltd, 2005.

REFERENCE BOOKS

1. K. Akkaya and M. Younis, "A survey of routing protocols in wireless sensor networks", Elsevier Ad Hoc Network Journal, Vol. 3, no. 3, pp. 325--349
2. Philip Levis, "TinyOS Programming"
3. Anna Ha´c, "Wireless Sensor Network Designs", John Wiley & Sons Ltd,

CSC203	Technical Report Writing	0-0-4	Credits 2

Course Objective:

This course provides students with an introduction to technical writing, complex graphics, and computer presentations with LATEX, which is the de-facto standard in computer science, mathematics and many of the sciences (and gaining traction in: economics, philosophy, and political science). The course offers techniques for writing documents (from single page letters to large complex book-like documents), preparing computer presentations, using and working with graphics in documents, and various techniques for creating complex graphics in an integrated manner.

Detail Syllabus:

Installation of the software LaTeX, Understanding Latex compilation, Basic Syntax, Structuring document, Adding paragraphs and sections, Adding figures in LaTeX, Embed an image/picture, Generate a table of contents in LaTeX, Tables in LaTeX, Writing Document Numbering, List of figures, List of tables, Generating index, Writing articles, Report Writing using Latex, Presentations – Beamer, BibLATEX.

Course Outcomes:

By the end of this course, students will have acquired proficiency with LATEX, as well as many powerful features of LATEX.

CSJ201	Pre-thesis work & Seminar - 2	0-0-2	Credits 2
In preparation of the thesis each student has to present a 30 minutes presentation on his / her research progress. The student has to submit a progress report containing problem statement, literature review of minimum 20 recent research publications in the working area and out comes if any. The report must be approved by the supervisor (s) and head of the department before the presentation.			

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

M.TECH SYLLABUS for *Specialization*: ENERGY SYSTEM ENGINEERING

BRANCH: ELECTRICAL ENGINEERING (2018-19 Admission Batch)

First Semester				Second Semester			
Theory				**Theory**			
Course Code	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**	**Course Code**	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**
	Programme Core-1	3-0-0	3		**Programme Core-3**	3-0-0	3
ESC101	Distributed Generation			ESC201	Digital Power System Protection		
	Programme Core-2	3-0-0	3		**Programme Core-4**	3-0-0	3
ESC102	Renewable Energy Systems			ESC202	Non-Conventional Electrical Energy Systems		
	Programme Elective-1 (Any One)	3-0-0	3		**Programme Elective-3 (Any One)**	3-0-0	3
ESE101	Engineering Optimization			ESE201	Artificial Intelligence Techniques		
ESE102	Power System Dynamics			ESE202	Smart Grids		
ESE103	High Voltage Engineering			ESE203	Energy Conversion Processes		
	Programme Elective-2 (Any One)	3-0-0	3		**Programme Elective-4 (Any One)**	3-0-0	3
ESE104	Switched Mode Power Control			ESE204	Electric and Hybrid Vehicles		
ESE105	Optimal and Adaptive Control			ESE205	Power Quality		
ESE106	FACTS and Custom Power Devices			ESE206	Industrial Load Modeling and Control		
GHM101	Research Methodology & Intellectual Property Rights	2-0-0	2		**Audit Course-2 (Any One from the list of Audit Courses)**	2-0-0	0
	Audit Course-1 (Any One from the list of Audit Courses)	2-0-0	0				
	Total (Theory)	**16**	**14**		**Total (Theory)**	**14**	**12**
	Practical/ Sessional				**Practical/ Sessional**		
	Lab-1	0-0-4	2		**Lab-3**	0-0-4	2
ESC103	Power Systems Lab-I			ESC203	Power System Lab-II		
	Lab-2	0-0-4	2		**Lab-4**	0-0-4	2
ESC104	Renewable Energy lab			ESC204	Energy Systems Simulation Lab		
				ESJ201	**Mini Project with Seminar**	0-0-4	2
	Total (Practical/ Sessional)	**8**	**4**		**Total (Practical/ Sessional)**	**12**	**6**
	TOTAL	**24**	**18**		**TOTAL**	**26**	**18**
TOTAL SEMESTER CREDITS: 18				TOTAL SEMESTER CREDITS: 18			
TOTAL CUMULATIVE CREDITS: 18				TOTAL CUMULATIVE CREDITS: 36			

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

M.TECH SYLLABUS for *Specialization*: ENERGY SYSTEM ENGINEERING

BRANCH: ELECTRICAL ENGINEERING (2018-19 Admission Batch)

Third Semester				Fourth Semester			
Theory				**Theory**			
Course Code	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**	**Course Code**	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**
	Programme Elective-5 (Any One)	3-0-0	3				
ESE301	Power System Analysis						
ESE302	Power system Transients						
ESE303	Reliability Analysis and Protection						
	Open Elective (Any One)	3-0-0	3				
	Business Analytics						
	Industrial Safety						
	Operations Research						
	Cost Management of Engineering Projects						
	Composite Materials						
	Waste to Energy						
	Internet of Things						
	Soft Computing						
	Project Engineering & Management						
	Start-up & Entrepreneurship Development						
	Total (Theory)	**6**	**6**		**Total (Theory)**	**0**	**0**
	Practical/ Sessional				**Practical/ Sessional**		
ESJ301	Dissertation Phase-I	0-0-20	10	ESJ401	Dissertation Phase-II	0-0-32	16
	Total (Practical/ Sessional)	**20**	**10**		**Total (Practical/ Sessional)**	**32**	**16**
	TOTAL	**26**	**16**		**TOTAL**	**32**	**16**
TOTAL SEMESTER CREDITS: 16				TOTAL SEMESTER CREDITS: 16			
TOTAL CUMULATIVE CREDITS: 52				TOTAL CUMULATIVE CREDITS: 68			

List of Audit courses

1. AHM101 English for Research Paper Writing
2. ACE101 Disaster Management
3. AHM102 Sanskrit for Technical Knowledge
4. AHM103 Value Education
5. AHM104 Constitution of India
6. AHM105 Pedagogy Studies
7. AHM106 Stress Management by Yoga
8. AHM107 Personality Development through Life Enlightenment Skills

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

M.TECH SYLLABUS for *Specialization*: ENERGY SYSTEM ENGINEERING

BRANCH: ELECTRICAL ENGINEERING (2018-19 Admission Batch)

1st Semester

ESC101	Distributed Generation	3-0-0	Credits 3

Course Objectives

Students will be able to

1. Understand renewable energysources.
2. Gain understanding of the working of off-grid and grid-connected renewable energy generation schemes.

Syllabus

MODULE-I **(12 Hours)**

Need for Distributedgeneration, Renewable sources in distributed generation, Current scenario in Distributed Generation, Planning of DGs, Sitting and sizing of DGs optimal placement of DG sources in distributionsystems, Grid integration of DGs Different types ofinterfaces, Inverter based DGs and rotating machine-based interfaces, Aggregation of multiple DGunits.

MODULE-II **(10 Hours)**

Technical impacts ofDGs, Transmission systems Distribution systems, De-regulation Impact of DGs upon protectiverelaying, Impact of DGs upon transient and dynamic stability of existing, distribution systems, Steady-state and Dynamicanalysis**.**

MODULE-III **(8 Hours)**

Economic and control aspects of DGs Marketfacts, Issues and challenges Limitations ofDGs, Voltage controltechniques, Reactive powercontrol, Harmonics Power quality issues, Reliability of DG basedsystems.

MODULE-IV **(12 Hours)**

Introduction to micro-grids, Typesof micro-grids: autonomous and non-autonomous grids Sizing ofmicro-grids, Modelling& analysis of Micro-grids with multiple DGs, Micro-grids with power electronic interfacingunits, Transients inmicro-grids, Protection ofmicro-grids, Case studies, advancedtopics.

Suggested reading

1. H. Lee Willis, Walter G. Scott, "Distributed Power Generation – Planning and Evaluation", Marcel Decker Press.
2. M.GodoySimoes, Felix A. Farret, "Renewable Energy Systems – Design and Analysis with Induction Generators", CRCpress.
3. Stuart Borlase. "Smart Grid: Infrastructure Technology Solutions" CRCPress.

Course outcomes: Students will be able to

1. Understand the planning and operational issues related to DistributedGeneration.
2. Acquire Knowledge about DistributedGeneratio
3. LearnMicro-Grids.

ESC102	Renewable Energy Systems	3-0-0	Credits 3

Course Objectives

Students will be able to

1. Learn various renewable energysources
2. Gain understanding of integrated operation of renewable energysources
3. Understand Power Electronics Interface with the Grid

Syllabus

MODULE-I **(10 Hours)**

Introduction, DistributedvsCentral StationGeneration, Sources of Energy such asMicro-turbines, Internal CombustionEngines**.**

MODULE-II **(10 Hours)**

Introduction to Solar Energy, WindEnergy, Combined Heat and Power, Hydro Energy, TidalEnergy, Wave Energy, Geothermal Energy, Biomass, FuelCells.

MODULE-III **(10 Hours)**

Power Electronic Interface with theGrid, Impact of Distributed Generation on the PowerSystem, Power QualityDisturbances.

MODULE-IV **(12 Hours)**

Transmission SystemOperation, Protection of DistributedGenerators, Economics of DistributedGeneration, Case Studies.

Suggested reading

1. Ranjan Rakesh, Kothari D.P, Singal K.C, "RenewableEnergySourcesandEmergingTechnologies", 2nd Ed. Prentice Hall of India,2011.
2. Math H. Bollen, Fainan Hassan, "Integration of Distributed Generation in the Power System", July 2011, Wiley –IEEEPress.

3. Loi Lei Lai, Tze Fun Chan, "Distributed Generation: Induction and Permanent MagnetGenerators", October 2007, Wiley-IEEEPress.
4. Roger A. Messenger, Jerry Ventre, "Photovoltaic System Engineering", 3rd Ed, 2010
5. James F. Manwell, Jon G. McGowan, Anthony L Rogers, "Wind energy explained: Theory Design and Application", John Wiley and Sons 2nd Ed,2010.

Course Outcomes

Students will be able to

1. Gain Knowledge about renewableenergy
2. Understand the working of distributed generation system in autonomous/grid connectedmodes
3. Know the Impact of Distributed Generation on PowerSystem

ESE101	Engineering Optimization	3-0-0	Credits 3

Course Objectives

Students will be able to

1. Understand the need for optimization and different techniques involved and also constraints.
2. Know Linear/Non-linearProgramming.
3. Understand the importance of optimization to solve Engineeringproblems
4. Know genetic algorithm for EngineeringOptimization

Syllabus

MODULE-I **(14 Hours)**

Concepts of optimization: Engineering applications -Statement of optimization problem-Classification - type and size of theproblem, Classical Optimization Techniques: Single and multi-variable problems- Types ofConstraints, Semi definite case-saddlepoint, Linear programming: Standardform, Geometry of LP problems, Theorem of LP- Relation toconvexity, Formulation of LP problems, Simplex method andalgorithm, Matrix form- two phase method, Duality- dual simplexmethod, LUDecomposition.

MODULE-II **(10 Hours)**

Sensitivityanalysis, Artificial variables and complementarysolutions-QP, Engineering Applications: Minimum cost flow problem, Network problems-transportation, Assignment & allocation, Scheduling, Karmarkar method-unbalanced and routingproblems, Nonlinear programming: Non linearityconcepts,

Convex and concave functions, Non-linear programming -gradient andHessian, Unconstrained optimization: First &Second order necessary conditions, Minimization & Maximization- Local & Global convergence-Speed of convergence.

MODULE-III **(10 Hours)**

Basic decent methods: Fibonacci & Golden sectionsearch, Gradient methods - Newton Method-Lagrange multipliermethod, Kuhn-tucker conditions, Quasi-Newton method- separable convex programming -Frank and Wolfemethod, Engineering Applications, Nonlinear programming, Constrained optimization: Characteristics of constraints-Direct methods-SLP, SQP, Indirect methods-Transformation techniques-penaltyfunction, Langrange multiplier methods checkingconvergence, Engineering applications.

MODULE-IV **(8 Hours)**

Dynamic programming: Multistage decision process, Concept of sub optimization and principle Ofoptimality, Computationalprocedure, Engineering applications, Geneticalgorithms, Simulated Annealing Methods, Optimization programming, tools and Softwarepackages.

Suggested reading

1. David G Luenberger, "Linear and Non-Linear Programming", 2nd Ed, Addison-Wesley Pub.Co., Massachusetts,2003
2. W.L. Winston, "Operation Research-Applications & Algorithms",2nd Ed., PWS-KENTPub.Co., Boston, 2007
3. S.S. Rao, "Engineering Optimization", 3rd Ed., New Age International (P) Ltd, New Delhi,2007
4. W.F. Stocker, "Design of Thermal Systems", 3rd Ed., McGraw Hill, New York.1990
5. G.B. Dantzig, "Linear Programming and Extensions" Princeton University Press, N.J.,1963
6. L.C.W. Dixton, "Non Linear Optimisation: theory and algorithms" Birkhauser, Boston,1980

Course Outcomes

Students will be able to

1. Apply optimization techniques to typical engineering problems
2. Learn the concepts and techniques of nonlinear and unconstrained optimization
3. Acquire knowledge on direct and indirect methods for constrained optimization
4. Learn the application of dynamic programming and genetic algorithms for engineering Optimization

ESE102	Power System Dynamics	3-0-0	Credits 3

Course Objectives

Students will be able to

1. Study of system dynamics and its physicalinterpretation
2. Development of mathematical models for synchronousmachine
3. Modeling of inductionmotor

Syllabus

MODULE-I **(10 Hours)**

Synchronous Machines: Per unitsystems. Park's Transformation (modified), Flux-linkageequations

MODULE-II **(10 Hours)**

Voltage and currentequations, Formulation of State-space equations, Equivalentcircuit.

MODULE-III **(12 Hours)**

Sub-transient and transient inductance and Timeconstants, Simplified models of synchronousmachines,

Small signal model: Introduction to frequencymodel.

MODULE-IV **(10 Hours)**

Excitation systems and Philips-Heffron model, PSS Loadmodelling**,** Modellingof Induction Motors, Prime mover controller.

Suggested reading

1. P. M. Anderson & A. A. Fouad "Power System Control and Stability", Galgotia , New Delhi,1981
2. J Machowski, J Bialek& J. R W. Bumby, "Power System Dynamics and Stability", John Wiley & Sons, 1997
3. P. Kundur, "Power System Stability and Control", McGraw Hill Inc.,1994.
4. E.W. Kimbark, "Power system stability", Vol. I & III, John Wiley & Sons, New York2002

Course Outcome

Students will be able to

1. Understand the modeling of synchronous machine indetails
2. Carry out simulation studies of power system dynamics using MATLAB-SIMULINK, MIPOWER
3. Carry out stability analysis with and without power system stabilizer (PSS)
4. Understand the load modeling in powersystem

ESE103	High Voltage Engineering	3-0-0	Credits 3

Course Objectives

Students will be able to

1. Get introduced to high voltageengineering

2. Understand different high voltage measurements and the necessaryinstruments

Syllabus

MODULE-I **(12 Hours)**

Voltage doubler, Cascade circuits, Electrostatic machines, Generation of Impulse voltages and currents: single stage and multistage circuits, Wave shaping-tripping and control of impulse generators.

MODULE-II **(10 Hours)**

Generation of switching surge voltage and impulse current Measurement of high voltages and currents, DC, AC and impulse voltages andcurrents, DSO-electrostatic and peak voltmeters-sphere gaps-factors affectingmeasurements, Potential dividers (capacitive and resistive)-series impedance ammeters, Rogowski coils-hall effect generators Digital techniques in HV measurements.

MODULE-III **(10 Hours)**

Measurement of electricfield, Sources of EMI, Principles of EMC, Filtering, Shielding, Grounding techniques, Introduction to relevant national and internationalstandards, Layout and clearances as well as shielding and grounding of HV lab.

MODULE-IV **(10 Hours)**

Safety regulations for high voltage tests, Calibration of HV measuring instruments, Indian Standards for HV clearances, Recent trends in HV Engineering.

Suggested reading

1. M. S. Naidu, V. Kamaraju, "High Voltage Engineering", McGraw-Hill, 1995.
2. M. Khalifa, "High Voltage Engineering: Theory and Practice", Dekker, 1990
3. H. M. Ryan, "High Voltage Engineering and Testing", Peter Peregrinus, 1994
4. WadhwaC L. “High Voltage Engineering”, Wiley Eastern Limited, NewDelhi, 1994
5. Ott, H.W. “Noise Reduction Techniques in Electronic Systems”, John Wiley, New York, 1989.

Course Outcomes

Students will be able to

1. Have knowledge about the need for high voltagegeneration
2. Acquaint with the different methods for generating high voltage AC/DC andimpulse voltages andcurrent
3. Have knowledge about the measurement techniques for high voltage AC/DC and impulse voltages and currents

4. Learn sources of EMI and its mitigationtechniques
5. Have safety precautions to be taken while designing an HVlab.

ESE104	Switched Mode Power Control	3-0-0	Credits 3

Course Objectives

Students will be able to

1. Understand different switch mode topologies & controlmethods
2. Understand different application of semiconductordevices

Syllabus

MODULE-I **(10 Hours)**

Introduction of Available Sources & Demandingloads, Sources - AC mains, Lab supplies, Batteries, SolarCells. Loads - Requirements of load, battery asload, Selection of Topology: Step-Up / Step-Down, Multipleoutputs, Continuous & discontinuous modes ofoperation.

MODULE-II **(10 Hours)**

Isolated converters, Various Configurations of Converters, Selection of Components: Selection of resister, chokes, Capacitors, Diodes, MoSFETs & IGBTs, Connectors.

MODULE-III **(12 Hours)**

Design of Magnetics Fundamentals & idealconditions, Design of High frequency chokes &transformers, Selection of wire gauge, Sealing ofmagnetic, Guide to Instrumentation, Basics of measurements using DMM, Oscilloscope, Electronic loads, etc.

MODULE-IV **(10 Hours)**

Design of Feedbackcircuits, Basic control requirements, Current & voltage mode control fundamentals & system stabilityconditions, Design of Control and Monitoringcircuits, Practical Control circuitry & Monitoring circuitryrequirements.

Suggested Reading

1. Ned Mohan, Undeland and Robbins, “Power Electronics Converters, Applications and Design”, John Wiley &sons.
2. Abraham I Pressman, Keith Billings, Taylor Morey, “Switching Power SupplyDesign”.

Course Outcomes

Students will be able to

1. Give practical step by step approach for design and assembly of Power Supplies and apply the necessary recent technology to comply the standards and certificationrequirements.
2. Have ability to design a system / component/process.

ESE105	Optimal and Adaptive Control	3-0-0	Credits 3

Course Objectives

Students will be able to

1. Know the operation of closed and open loop optimalcontrol
2. Understand the adaptive controlstrategies
3. Learn dynamic programmingmethod

Syllabus

MODULE-I **(12 Hours)**

Optimal control problem, Fundamental concepts and theorems of calculus ofvariations, Euler-Lagrange equation and external of functional, Variational approach to solving optimal control problems, Hamiltonian and different boundary conditions for optimal control problem.

MODULE-II **(10 Hours)**

Linear regulator problem, Pontryagin's minimum principle, Dynamic programming, Principle of optimality and its application to optimal control problem.

MODULE-III **(10 Hours)**

Hamilton-Jacobi-Bellman equation, Model reference adaptive systems (MRAS) – Design hypothesis.

MODULE-IV **(10 Hours)**

Introduction to design method based on the use of Liapunov function, Design and simulation of variable structure adaptive model following control.

Suggested reading

1. Donald E. Kirk, "Optimal Control Theory, An introduction." Prentice Hall Inc.,2004
2. A.P. Sage, "Optimum Systems Control", Prentice Hall, 1977
3. HSU and Meyer, "Modern Control, Principles and Applications," McGraw Hill,1968
4. Yoan D. Landu, "Adaptive Control" (Model Reference Approach), Marcel Dekker. 1981
5. K.K.D. Young, Design of Variable Structure Model Following Control Systems, IEEE Transactions on Automatic Control, Vol. 23, pp 1079-1085,1978.

Course Outcomes

Students will be able to

1. Have knowledge in the mathematical area of calculus of variation so as to apply the same for solving optimal controlproblems
2. Know Problem formulation, performance measure and mathematical treatment of optimal control problems
3. Acquire knowledge on solving optimal control design problems by taking into consideration the physical constraints on practical controlsystems
4. Obtain optimal solutions to controller design problems taking into consideration the limitation on control energy in the real practicalworld.

ESE106	FACTS and Custom Power Devices	3-0-0	Credits 3

Course Objectives

Students will be able to

1. Learn the active and reactive power flow control in powersystem
2. Understand the need for staticcompensators
3. Develop the different control strategies used forcompensation

Syllabus

MODULE-I **(10 Hours)**

Reactive power flow control in PowerSystems, Control of dynamic power unbalances in PowerSystem,

Power flow control-Constraints of maximum transmission lineloading, Benefits of FACTS Transmission line compensation- Uncompensated line - Shunt compensation - Series compensation –Phase angle control,

Reactive power compensation – Shunt and Series compensationprinciples– Reactive compensation at transmission and distribution level.

MODULE-II **(12 Hours)**

Static versus passive VAR compensator, Static shunt compensators: SVC, STATCOM - Operation and control of TSC, TCR and STATCOM- Compensatorcontrol, Comparison between SVC and STATCOM, Static series compensation: TSSC, SSSC -Static voltage and phaseangle regulators – TCVR and TCPAR, Operation and Control–Applications, Static series compensation– GCSC, TSSC, TCSC, Static synchronous series compensators and theirControl.

MODULE-III **(10 Hours)**

SSR and its damping Unified Power Flow Controller: CircuitArrangement, Operation and control of UPFC-

Basic Principle of P and Qcontrol, Independent real and reactive power flow control-Applications, Introduction to interline power flowcontroller, Modeling and analysis of FACTSControllers – Simulation of FACTS controllers Power quality problems in distributionsystems.

MODULE-IV **(10 Hours)**

Harmonics, loads that create harmonics, modeling, harmonic propagation, series and parallel resonances, mitigation ofharmonics, Passive filters, active filtering – shunt, series and hybrid and theircontrol,

Voltage swells, sags, flicker, unbalance and mitigation of these problems by power lineconditioners, IEEE standards on powerquality.

Suggested reading

1. K.R Padiyar, "FACTS Controllers in Power Transmission and Distribution" New Age International Publishers, 2007. X P Zhang, C Rehtanz, B Pal, "Flexible AC Transmission Systems- Modelling and Control", Springer Verlag, Berlin, 2006.
2. N.G. Hingorani, L. Gyugyi, "Understanding FACTS: Concepts and Technology of Flexible ACTransmission Systems", IEEE Press Book, Standard Publishers and Distributors, Delhi,2001.
3. K.S. Suresh kumar, S. Ashok, "FACTSControllers&Applications", E-bookedition, Nalanda Digital Library, NITCalicut,2003
4. G T Heydt, "Power Quality", McGraw-Hill Professional,2007
5. T J E Miller, "Static Reactive Power Compensation", John Wiley and Sons, Newyork,1982.

Course Outcomes

Students will be able to

1. Acquire knowledge about the fundamental principles of Passive and Active Reactive Power Compensation Schemes at Transmission and Distribution level in PowerSystems.
2. Learn various Static VAR Compensation Schemes like Thyristor/GTO Controlled Reactive Power Systems; PWM Inverter based Reactive Power Systems and their controls.
3. Develop analytical modeling skills needed for modeling and analysis of such StaticVAR Systems.

ESC103	Power Systems Lab-I	0-0-4	Credits 2

List of Experiments:

1. Determination of ABCD parameters of a long transmission line.
2. Study of Ferranti effect.
3. Study of Buchholtz relay.
4. Study of SCADA monitoring system of a power system.
5. Study of IDMT relay.
6. Study of a photo voltaic analyzer.
7. Simulation of automatic load frequency control of 1-area and 2- area systems.
8. Development of Ybus matrix of a IEEE-14 bus power system using MATLAB simulation.
9. Shunt reactor compensation for unloaded transmission line.
10. Shunt capacitor compensation of a transmission line.
11. Power system fault studies using distance relay and short circuit relay.

*Any other experiments if found suitable, however the total number of experiments should not be less than 8.

ESC104	Renewable Energy lab	0-0-4	Credits 2

List of experiments:

1. To determine the efficiency of Solar PV panel at different irradiance levels
2. To determine the efficiency of a wind turbine for different wind speeds
3. Test the Capabilities of the Hydrogen Fuel Cells and Capacitors.
4. Effect of Temperature on Solar Panel Output
5. Variables Affecting Solar Panel Output
6. Effect of Load on Solar Panel Output
7. Wind Turbine Output: The Effect of Load
8. Test the Capabilities of Solar Panels and Wind Turbines

GHM101	Research Methodology & Intellectual Property Rights	2-0-0	Credits 2

MODULE-I **(06 Hours)**

Meaning of research problem, Sources of research problem, Criteria characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.

Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

MODULE-II **(04 Hours)**

Effective literature studies approaches, analysis,

Plagiarism, Research ethics.

MODULE-III **(04 Hours)**

Effective technical writing, how to write report, Paper.

Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

MODULE-IV **(06 Hours)**

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

MODULE-V **(04 Hours)**

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

MODULE-VI **(04 Hours)**

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Text/Reference Books:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science& engineering students".
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.

5. Mayall, “Industrial Design”, McGraw Hill, 1992.
6. Niebel, “Product Design”, McGraw Hill, 1974.
7. Asimov, “Introduction to Design”, Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “Intellectual Property in New Technological Age”, 2016.
9. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008

Course Outcomes: At the end of the course, students will be able to

1. Understand research problem formulation.
2. Analyze research related information
3. Follow research ethics
4. Understand that today’s world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property.

   Right to be promoted among students in general & engineering in particular.
6. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Audit Courses

AHM101	English for Research Paper Writing	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Understand that how to improve your writing skills and level of readability
2. Learn about what to write in each section
3. Understand the skills needed when writing a Title

   Ensure the good quality of paper at very first-time submission

MODULE-I **(4 Hours)**

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

MODULE-II **(4 Hours)**

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction.

MODULE-III **(4 Hours)**

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

MODULE-IV **(4 Hours)**

key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed whenwriting a Review of the Literature.

MODULE-V **(4 Hours)**

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions.

MODULE-VI **(4 Hours)**

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

Suggested Studies:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book.

4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

ACE101	Disaster Management	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

MODULE-I **(4 Hours)**

Introduction

Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

MODULE-II **(4 Hours)**

Repercussions of Disasters and Hazards:

Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem.

Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

MODULE-III **(4 Hours)**

Disaster Prone Areas in India

Study of Seismic Zones; Areas Prone to Floods And Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics

MODULE-IV **(4 Hours)**

Disaster Preparedness and Management

Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, Media Reports: Governmental and

Community Preparedness.

MODULE-V **(4 Hours)**

Risk Assessment

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategiesfor Survival.

MODULE-VI **(4 Hours)**

Disaster Mitigation

Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation In India.

Text / Reference Books:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies, NewRoyal book Company.
2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences and Reflections", Prentice Hall OfIndia, New Delhi.
3. Goel S. L., Disaster Administration and Management Text And Case Studies", Deep &Deep Publication Pvt. Ltd., New Delhi.

AHM102	Sanskrit for Technical Knowledge	2-0-0	Credits 0

Course Objectives:

1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. Learning of Sanskrit to improve brain functioning
3. Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power
4. The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature

MODULE-I **(8 Hours)**

- Alphabets in Sanskrit
- Past/Present/Future Tense
- Simple Sentences

MODULE-II **(8 Hours)**

- Order
- Introduction of roots
- Technical information about Sanskrit Literature

MODULE-III **(8 Hours)**

- Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

Suggested reading:

1. "Abhyaspustakam" – Dr. Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

Course Output: Students will be able to

1. Understanding basic Sanskrit language
2. Ancient Sanskrit literature about science & technology can be understood
3. Being a logical language will help to develop logic in students

AHM103	Value Education	2-0-0	Credits 0

Course Objectives: Students will be able to

1. Understand value of education and self- development
2. Imbibe good values in students
3. Know about the importance of character

MODULE-I **(6 Hours)**

- Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism.
- Moral and non- moral valuation. Standards and principles.
- Value judgements

MODULE-II **(6 Hours)**

- Importance of cultivation of values.
- Sense of duty.Devotion, Self-reliance.Confidence, Concentration. Truthfulness, Cleanliness.
- Honesty, Humanity.Power of faith, National Unity.
- Patriotism.Love for nature, Discipline

MODULE-III **(6 Hours)**

- Personality and Behavior Development - Soul and Scientific attitude.
- Positive Thinking. Integrity and discipline.
- Punctuality, Love and Kindness.
- Avoid fault Thinking.
- Free from anger, Dignity of labour.
- Universal brotherhood and religious tolerance.
- True friendship.
- Happiness Vs suffering, love for truth.
- Aware of self-destructive habits.
- Association and Cooperation.
- Doing best for saving nature

MODULE-IV **(6 Hours)**

- Character and Competence –Holy books vs Blind faith.
- Self-management and Good health.
- Science of reincarnation.
- Equality, Nonviolence, Humility, Role of Women.
- All religions and same message.
- Mind your Mind, Self-control.
- Honesty, Studying effectively

Text / Reference Books

1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

Course outcomes: Students will be able to

1. Knowledge of self-development

2. Learn the importance of Human values
3. Developing the overall personality

AHM104	Constitution of India	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutionalrole and entitlement to civil and economic rights as well as the emergence of nationhood inthe early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the BolshevikRevolution in 1917 and its impact on the initial drafting of the Indian Constitution.

MODULE-I **(4 Hours)**

- **History of Making of the Indian Constitution:**

  History

  Drafting Committee, (Composition& Working)

MODULE-II **(4 Hours)**

- **Philosophy of the Indian Constitution:**

  Preamble

  Salient Features

MODULE-III **(4 Hours)**

- **Contours of Constitutional Rights & Duties:**

  Fundamental Rights

  Right to Equality

  Right to Freedom

  Right against Exploitation

  Right to Freedom of Religion

  Cultural and Educational Rights

  Right to Constitutional Remedies

  Directive Principles of State Policy

Fundamental Duties.

MODULE-IV **(4 Hours)**

- **Organs of Governance:**

  Parliament

  Composition

  Qualifications and Disqualifications

  Powers and Functions

  Executive

  President

  Governor

  Council of Ministers

  Judiciary, Appointment and Transfer of Judges, Qualifications

  Powers and Functions

MODULE-V **(4 Hours)**

- **Local Administration:**

  District's Administration head: Role and Importance,

  Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation.

  Pachayati raj: Introduction, PRI: ZilaPachayat.

  Elected officials and their roles, CEO ZilaPachayat: Position and role.

  Block level: Organizational Hierarchy (Different departments),

  Village level: Role of Elected and Appointed officials,

  Importance of grass root democracy

  Model Curriculum of Engineering & Technology PG Courses [Volume -II]

MODULE-VI **(4 Hours)**

- **Election Commission:**

  Election Commission: Role and Functioning.

  Chief Election Commissioner and Election Commissioners.

  State Election Commission: Role and Functioning.

  Institute and Bodies for the welfare of SC/ST/OBC and women.

Text / Reference Books:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Outcomes: Students will be able to:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the passage of the Hindu Code Bill of 1956.

AHM105	Pedagogy Studies	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Review existing evidence on the review topic to inform programme design and policymaking undertaken by the DfID, other agencies and researchers.
2. Identify critical evidence gaps to guide the development.

MODULE-I **(4 Hours)**

- **Introduction and Methodology:**
- Aims and rationale, Policy background, Conceptual framework and terminology
- Theories of learning, Curriculum, Teacher education.
- Conceptual framework, Research questions**.**
- Overview of methodology and Searching.

MODULE-II **(2 Hours)**

- Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries.
- Curriculum, Teacher education.

MODULE-III **(4 Hours)**

- Evidence on the effectiveness of pedagogical practices
- Methodology for the in depth stage: quality assessment of included studies.
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?
- Theory of change.
- Strength and nature of the body of evidence for effective pedagogical practices.
- Pedagogic theory and pedagogical approaches.
- Teachers' attitudes and beliefs and Pedagogic strategies.

MODULE-IV **(4 Hours)**

- Professional development: alignment with classroom practices and follow up support
- Peer support
- Support from the head teacher and the community.
- Curriculum and assessment
- Barriers to learning: limited resources and large class sizes

MODULE-V **(2 Hours)**

- **Research gaps and future directions**
- Research design
- Contexts
- Pedagogy
- Teacher education
- Curriculum and assessment
- Dissemination and research impact.

Text / Reference Books:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2):245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal ofCurriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic

maths and reading in Africa: Does teacher preparation count? International JournalEducational Development, 33 (3): 272–282.

5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

Course outcomes: Students will be able to understand:

1. What pedagogical practices are being used by teachers in formal and informal classrooms indeveloping countries?
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, andwith what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

AHM106	Stress Management by Yoga	2-0-0	Credits 0

Course Objectives:

1. To achieve overall health of body and mind
2. To overcome stress

MODULE-I **(8 Hours)**

- Definitions of Eight parts of yoga. (Ashtanga)

MODULE-II **(8 Hours)**

- Yam and Niyam.

  Do`s and Don't's in life.

  i) Ahinsa, satya, astheya, bramhacharya and aparigraha

  ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

MODULE-III **(8 Hours)**

- Asan and Pranayam

  i) Various yog poses and their benefits for mind & body

ii) Regularization of breathing techniques and its effects-Types of pranayam

Text / Reference Books:

1. 'Yogic Asanas for Group Tarining-Part-I": Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

Course outcomes: Students will be able to:

1. Develop healthy mind in a healthy body thus improving social health also
2. Improve efficiency

AHM107	Personality Development through Life Enlightenment Skills	2-0-0	Credits 0

Course Objectives:

1. To learn to achieve the highest goal happily
2. To become a person with stable mind, pleasing personality and determination
3. To awaken wisdom in students

MODULE-I **(8 Hours)**

Neetisatakam-Holistic development of personality

- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)
- Verses- 52,53,59 (dont's)
- Verses- 71,73,75,78 (do's)

MODULE-II **(8 Hours)**

Approach to day to day work and duties.

- Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48,
- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,
- Chapter 18-Verses 45, 46, 48.

MODULE-III **(8 Hours)**

Statements of basic knowledge.

- Shrimad Bhagwad Geeta: Chapter 2- Verses 56, 62, 68
- Chapter 12 - Verses 13, 14, 15, 16,17, 18
- Personality of Role model. Shrimad Bhagwad Geeta: Chapter2-Verses 17, Chapter 3- Verses 36,37,42,
- Chapter 4- Verses 18, 38,39
- Chapter18 – Verses 37,38,63

Text / Reference Books:

1. "Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P. Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

Course outcomes: Students will be able to:

1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achievethe highest goal in life
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity
3. Study of Neetishatakam will help in developing versatile personality of students.

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

M.TECH SYLLABUS for *Specialization*: ENERGY SYSTEM ENGINEERING

BRANCH: ELECTRICAL ENGINEERING (2018-19 Admission Batch)

2nd Semester

ESC201	Digital Power System Protection	3-0-0	Credits 3

Course Objectives

Students will be able to

1. Study numericalrelays
2. Develop mathematical approach towardsprotection
3. Study algorithms for numericalprotection

Syllabus

MODULE-I **(12 Hours)**

Evolution of digital relays from electromechanicalrelays, Performance and operational characteristics of digitalprotection, Mathematical Background to Protection Algorithms: Finite Difference Techniques, Interpolation formulae: Forward, backward and interpolation, Numerical differentiation, Curve fitting andsmoothing, Least squares method, Fourier analysis, Fourier series and Fourier transform, Walsh function analysis.

MODULE-II **(10 Hours)**

Basic elements of digital protection: Signal conditioning: transducers, surge protection, analog filtering, analogmultiplexers, Conversion subsystem: the sampling theorem, signal aliasing error, sample and hold circuits, multiplexers, analog to digitalconversion, Digital filteringconcepts.

MODULE-III **(8 Hours)**

The digital relay as a unit consisting of hardware andsoftware, Sinusoidal wave based algorithms: Sample and first derivative (Mann and Morrison) algorithm, Fourier and Walsh basedalgorithms.

MODULE-IV **(12 Hours)**

Fourier Algorithm: Full cycle window algorithm, fractional cycle window algorithm, Walsh function based algorithm, Least Squares basedalgorithms, Differential equation basedalgorithms, Traveling Wave basedTechniques, Digital Differential Protection of Transformers, Digital Line Differential Protection, Recent Advances in Digital Protection of PowerSystems.

Suggested reading

1. A.G. Phadke and J. S. Thorp, "Computer Relaying for Power Systems", Wiley/Research studies Press, 2009
2. A.T. Johns and S. K. Salman, "Digital Protection of Power Systems", IEEEPress, 1999
3. Gerhard Zeigler, "Numerical Distance Protection", Siemens Publicis Corporate Publishing,2006

4. S.R. Bhide “Digital Power System Protection” PHI Learning Pvt. Ltd. 2014.

Course Outcomes

Students will be able to

1. Learn the importance of DigitalRelays.
2. Apply Mathematical approach towardsprotection
3. Learn to develop various Protectionalgorithms

ESC202	Non-Conventional Electrical Energy Systems	3-0-0	Credits 3

Course Objectives:

Students will be able to:

1. Understand Basic electrical drives and their analysis.
2. Learn Design of controller for drives.
3. Understand Scalar control of electrical drives.

Syllabus

MODULE-I **(10 Hours)**

Dynamics of Electric Drives: Fundamentals of torque equation, Speed torque convention and Multi-quadrant operation, components of load torques. Classification of load torques steady state stability, Load equation, Speed control and drive classification, close loop control of drives.

MODULE-II **(10 Hours)**

DC motor Drives: Modeling of DC machines, Steady state characteristics with armature and speed control, Phase controlled DC motor drives, chopper controlled DC motor drives.

MODULE-III **(12 Hours)**

Poly-phase induction machines: Dynamic modeling of induction machines, Small signal equations, control characteristics of induction machines, Phase-controlled induction machines, Stator voltage control, Slip energy recovery scheme, frequency control and vector control of induction motor drives.

MODULE-IV **(10 Hours)**

Traction motor: starting, speed-time characteristics, braking, Traction motors used in practice. Industrial Drives: Digital Control of Electric Drives, Stepper motor, Servo motor and their Applications.

Suggested reading

1. G.K, Dubey, "Power semiconductor controlled Drives", Prentice Hall international, New Jersey,

1989.
2. R. Krishanam, "Electric motor drives modeling, analysis and control", PHI-India-2009.
3. G. K. Dubey, "Fundamentals of electric Drives, Narosa Publishing House", 2nd edition,2011.
4. W. Leonhard, "Control of Electrical drives", Springer, 3rd edition, 2001.
5. P.C. Krause –, "Analysis of Electric Machine", Wiley-IEEE press3rdedition.
6. K. Bose, "Modern Power Electronics and AC Drives", Prentice Hall publication, 1st edition, 2001.

Course Outcomes:

Students will be able to:

1. Model and simulate electric drive systems
2. Design modulation strategies of power electronics converters, for drives application
3. Design appropriate current/voltage regulators for electric drives
4. Select and implement the drives for Industrial Process Implement various variable speed drives in Electrical Energy Conversion System

ESE201	Artificial Intelligence Techniques	3-0-0	Credits 3

Course Objectives

Students will be able to

1. Understand fuzzylogic, ANN
2. Understand GA &EP

Syllabus

MODULE-I **(12 Hours)**

Biological foundations to intelligent Systems: Artificial Neural Networks, Single layer and Multilayer Feed ForwardNN, LMS and Back Propagation Algorithm, Feedback networks and Radial Basis FunctionNetworks.

MODULE-II **(8 Hours)**

FuzzyLogic, Knowledge Representation and Inference Mechanism, DefuzzificationMethods

MODULE-III **(14 Hours)**

Fuzzy Neural Networks and some algorithms to learn the parameters of the network likeGA, System Identification using Fuzzy and NeuralNetwork, Genetic algorithm, Reproduction, Crossover, Mutation, Introduction to evolutionary program.

MODULE-IV **(8 Hours)**

Applications of above mentioned techniques to practicalproblems.

Suggested reading

1. J M Zurada, "An Introduction to ANN", Jaico Publishing House.
2. Simon Haykins, "Neural Networks", Prentice Hall.
3. Timothy Ross, "Fuzzy Logic with Engg. Applications", McGraw.Hill.
4. Driankov, Dimitra, "An Introduction to Fuzzy Control", NarosaPublication.
5. Golding, "Genetic Algorithms", Addison-Wesley Publishing Com.

Course Outcomes

Students will be able to

1. Learn the concepts of biological foundations of artificial neural networks
2. Learn Feedback networks and radial basis function networks and fuzzy logics
3. Identify fuzzy and neuralnetwork
4. Acquire the knowledge of GA

ESE202	Smart Grids	3-0-0	Credits 3

Course Objectives

Students will be able to

1. Understand concept of smart grid and its advantages over conventionalgrid
2. Know smart meteringtechniques
3. Learn wide area measurementtechniques
4. Understand the problems associated with integration of distributed generation & its solution through smartgrid.

Syllabus

MODULE-I **(12 Hours)**

Introduction to SmartGrid, Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of SmartGrid, Concept of Robust &Self HealingGrid, Present development & International policies in SmartGrid, Introduction to SmartMeters, Real Time Prizing, Smart Appliances, Automatic Meter Reading (AMR), Outage Management System (OMS), Plug in Hybrid ElectricVehicles (PHEV), Vehicle to Grid,

Smart Sensors, Home & Building Automation, Smart Substations, Substation Automation, Feeder Automation.

MODULE-II **(8 Hours)**

Geographic Information System (GIS), Intelligent Electronic Devices (IED) & their application for monitoring &protection, Smart storage likeBattery, SMES, Pumped Hydro, Compressed Air Energy Storage, Wide Area MeasurementSystem (WAMS), Phase Measurement Unit (PMU).

MODULE-III **(10 Hours)**

Concept of micro-grid, Need & applications of micro-grid, Formation ofmicro-grid, Issues of Interconnection, Protection & control of micro-grid, Plastic & Organic solarcells, Thin film solarcells, Variable speed windgenerators, Fuel-cells, Micro-turbines, Captive powerplants, Integration of renewable energy sources.

MODULE-IV (**12 Hours)**

Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Neighborhood Area Network (NAN), Wide Area Network (WAN), Bluetooth, ZigBee, GPS, Wi-Fi. Wi-Max basedcommunication, Wireless MeshNetwork, Basics of CLOUD Computing & Cyber Security for Smart Grid. Broadband over Power line (BPL), IP basedprotocols.

Suggested reading

1. Ali Keyhani, "Design of smart power grid renewable energy systems", Wiley IEEE, 2011.
2. Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response", CRC Press, 2009.
3. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, "Smart Grid: Technology and Applications", Wiley 2012.
4. StuartBorlase, "Smart Grid: Infrastructure, Technology and solutions", CRC Press.
5. A.G. Phadke, "Synchronized Phasor Measurement and their Applications", Springer.

Course Outcomes

Students will be able to

1. Appreciate the difference between smart grid & conventionalgrid
2. Apply smart metering concepts to industrial and commercialinstallations
3. Formulate solutions in the areas of smart substations, distributed generation and wide areameasurements
4. Come up with smart grid solutions using modern communicationtechnologies

ESE203	Energy Conversion Processes	3-0-0	Credits 3

Course Objectives

Students will be able to

1. Analysis of different energy system likesolar
2. Understand design aspects of MHDgenerators
3. Understand Fuel cell & theirapplications

Syllabus

MODULE-I **(12 Hours)**

Basic science of energy conversion, Indirect verses direct conversion, Physics of semiconductor junctions for photovoltaic and photo- electrochemical conversion of solarenergy, Fabrication and evaluation of various solar cells in photovoltaic power generationsystems.

MODULE-II **(12 Hours)**

Technology and physics of thermo-electric generations, Thermal-electric materials and optimization studies, Basic concepts and design considerations of MHD generators Cycle analysis of MHDsystems.

MODULE-III **(10 Hours)**

Thermonic power conversion and plasmadiodes, Thermodynamics and Performance of fuel cells and their applications.

MODULE-IV **(8 Hours)**

Advanced topics in Energy ConversionProcess

Suggested reading

1. S. S. L. Chang, “Energy Conversion”, Prentice Hall, 1963.16
2. S. W. Angrist, “Direct Energy Conversion”, Pearson,1982
3. R. J. Rosa, “Magneto hydrodynamic Energy Conversion”, Springer,1987
4. V. S. Bagotsky, “Fuel Cell Problems and Solutions”, John Wiley & Sons,2009

Course Outcomes

Students will be able to

1. Have knowledge about Physics of semiconductor junctions for photovoltaic and photo- electro chemicalconversion
2. Carry out Cycle analysis of MHDsystems
3. Know Different thermo-electric processes of electric materials and their efficientuse

ESE204	Electric and Hybrid Vehicles	3-0-0	Credits 3

Course Objectives

Students will be able to

1. Understand upcoming technology of hybridsystem
2. Understand different aspects of drivesapplication
3. Learn the electricTraction

Syllabus

MODULE-I **(8 Hours)**

History of hybrid and electric vehicles, Social and environmental importance of hybrid and electric vehicles, Impact of modern drive-trains on energy supplies, Basics of vehicle performance, Vehicle power source characterization, Transmission characteristics, Mathematical models to describe vehicle performance.

MODULE-II **(12 Hours)**

Basic concept of hybrid traction, Introduction to various hybrid drive-train topologies, Power flow control in hybrid drive-train topologies, Fuel efficiencyanalysis, Basic concepts of electrictraction, Introduction to various electric drive-traintopologies, Power flow control in hybrid drive-traintopologies, Fuel efficiencyanalysis.

MODULE-III **(10 Hours)**

Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motordrives, Configuration and control of Introduction Motordrives, Configuration and control of Permanent Magnet Motordrives, Configuration and control of Switch Reluctance Motordrives, Drive systemefficiency.

MODULE-IV **(12 Hours)**

Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, Sizing the power electronics, Selecting the energy storage technology, Communications, Supporting subsystems, Introduction to energy management and their strategies used in hybrid and electricvehicle, Classification of different energy management strategies, Comparison of different energy management strategies, Implementation issues of energystrategies.

Suggested reading

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
2. MehrdadEhsani, yimiGao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
3. JamesLarminie, John Lowry, Electric vehicle Technology Explained, Wiley 2003.

Course Outcomes

Students will be able to

1. Acquire knowledge about fundamental concepts, principles, analysis and design of hybrid and electricvehicles.
2. Learn electric drive in vehicles /traction.

ESE205	Power Quality	3-0-0	Credits 3

Course Objectives:

Students will be able to:

1. Understand the different power quality issues to be addressed
2. Understand the recommended practices by various standard bodies like IEEE, IEC, etc. on voltage & frequency, harmonics
3. Understanding STATIC VAR Compensators

Syllabus

MODULE-I **(12 Hours)**

Introduction-power quality- voltage quality-overview of power, Quality phenomena classification of power quality issues, Power quality measures and standards- THD-TIF-DIN-C-message weights, Flicker factor transient phenomena-occurrence of power quality problems, Power acceptability curves-IEEE guides, Standards and recommended practices. Harmonics- individual and total harmonic distortion, RMS value of a harmonic waveform, Triplex harmonics. Important harmonic introducing devices. SMPS, Three phase power converters-arcing devices saturable devices, Harmonic distortion of fluorescent lamps-effect of power system harmonics on power system equipment and loads.

MODULE-II **(10 Hours)**

Modeling of networks and components under non-sinusoidal conditions, Transmission and distribution systems, Shunt capacitors-transformers, Electric machines, Ground systems loads that cause power quality problems, Power quality problems created by drives and its impact on drive.

MODULE-III **(10 Hours)**

Power factor improvement- Passive Compensation, Passive Filtering. Harmonic Resonance. Impedance Scan Analysis, Active Power Factor Corrected Single Phase Front End, Control Methods for Single Phase APFC, Three Phase APFC and Control Techniques, PFC based on Bilateral Single Phase and Three Phase Converter.

MODULE-IV **(10 Hours)**

Hamilton-Jacobi-Bellman model reference adaptive systems Equation (MRAS) – Design hypothesis

Introduction to design method based on the use of Liapunov function, Design and simulation of variable structure adaptive model following control.

Suggested reading

1. G.T. Heydt, "Electric power quality", McGraw-Hill Professional, 2007
2. Math H. Bollen, "Understanding Power Quality Problems", IEEE Press, 2000
3. J. Arrillaga, "Power System Quality Assessment", John wiley, 2000
4. J. Arrillaga, B.C. Smith, N.R. Watson &A. R. Wood, "Power system Harmonic Analysis", Wiley, 1997

Course Outcomes:

Students will be able to:

1. Acquire knowledge about the harmonics, harmonic introducing devices and effect of harmonics on system equipment and loads
2. develop analytical modeling skills needed for modeling and analysis of harmonics in networks and components
3. To introduce the student to active power factor correction based on static VAR compensators and its control techniques
4. To introduce the student to series and shunt active power filtering techniques for harmonics.

ESE206	Industrial Load Modeling and Control	3-0-0	Credits 3

Course Objectives

Students will be able to

1. Understand the energy demandscenario
2. Understand the modeling of load and its ease to study load demandindustrially
3. Know Electricity pricingmodels
4. Study Reactive power management inIndustries

Syllabus

MODULE-I **(12 Hours)**

Electric Energy Scenario-Demand Side Management-Industrial LoadManagement, Load Curves-Load ShapingObjectives-Methodologies-Barriers, Classification of Industrial Loads- Continuous andBatch processes-Load Modelling, Electricity pricing – Dynamic and spot pricing–Models, Direct load control-Interruptible loadcontrol, Bottom up approach- scheduling- Formulation of loadmodels, Optimization and control algorithms. Case studies

MODULE-II **(12 Hours)**

Reactive power management inindustries-controls, Power quality impacts-application of filters Energy saving in industries, Cooling and heatingloads, Load Profiling-Modeling, Cool Storage-Types-Control strategies, Optimaloperation, Problemformulation, Case studies.

MODULE-III **(8 Hours)**

Captive power units- Operating and controlstrategies, Power Pooling- Operationmodels, Energybanking, IndustrialCogeneration.

MODULE-IV **(8 Hours)**

Selection of Schemes Optimal Operating Strategies-Peak load saving, Constraints, Problem formulation-Casestudy, Integrated Load management forIndustries.

Suggested reading

1. C.O. Bjork " Industrial Load Management - Theory, Practice and Simulations", Elsevier, theNetherlands,1989
2. C.W. Gellings and S.N. Talukdar, . Load management concepts. IEEE Press, New York, 1986,pp. 3-28
3. Y. Manichaikul and F.C. Schweppe," Physically based Industrial load", IEEE Trans. on PAS, April 1981
4. H. G. Stoll, "Least cost Electricity Utility Planning", Wiley Interscience Publication, USA, 1989.
5. I.J. Nagarath and D.P. Kothari, Modern Power System Engineering., Tata McGraw Hill publishers, NewDelhi, 1995
6. IEEE Bronze Book- "Recommended Practice for Energy Conservation and cost effective planning in Industrial facilities", IEEE Inc,

Course Outcomes

Students will be able to

1. Know about load control techniques in industries and its application
2. Learn different types of industrial processes and optimize the process using tools like LINDO and LINGO
3. Apply load management to reduce demand of electricity during peak time
4. Apply different energy saving opportunities in industries

ESC203	Power System Lab-II	0-0-4	Credits 2

List of experiments:

1. Introduction to Power System Protection
2. Impact of Induction Motor Starting on Power System
3. Modelling of Differential Relay using MATLAB

4. Radial Feeder Protection
5. Parellel Feeder Protection
6. Principle of Reverse Power Protection
7. Differential Protection of Transformer
8. To the study time vs. voltage characteristics of over voltage induction relay.

ESC204	Energy Systems Simulation Lab	0-0-4	Credits 2

List of experiments:

1. Determine the efficiency of Solar PV Grid-Tied system using MATLAB
2. Determine the efficiency of Wind Energy System using MATLAB
3. Modelling and simulation of a biogas plant
4. Study of a geothermal system
5. Modelling and simulation of a fuel cell
6. Modelling and simulation of a mini hydro plant
7. Modelling and simulation of grid integration of multiple renewable energy sources

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

M.TECH SYLLABUS for *Specialization*: ENERGY SYSTEM ENGINEERING

BRANCH: ELECTRICAL ENGINEERING (2018-19 Admission Batch)

3rd Semester

ESE301	Power System Analysis	3-0-0	Credits 3

Course Objectives-

Students will be able to:

1. Study various methods of load flow and their advantages anddisadvantages
2. Understand how to analyze various types of faults in powersystem
3. Understand power system security concepts and study the methods to rank thecontingencies
4. Understand need of state estimation and study simple algorithms for stateestimation
5. Study voltage instabilityphenomenon

Syllabus

MODULE-I **(11 Hours)**

Load flow**:** Overview of Newton-Raphson, Gauss-Siedelfast decoupled methods, convergence properties, sparsity techniques, handling Q- max violations in constant matrix, inclusion in frequencyeffects AVR in load flow, handling of discrete variable in loadflow. Fault Analysis**:** Simultaneousfaults, open conductorsfaults, generalized method of faultanalysis.

MODULE-II **(11 Hours)**

Security Analysis: Security state diagram, contingency analysis, generator shift distributionfactorsline outage distribution factor, multiple lineoutages, overload indexranking Power System Equivalents**:** WARD, REI equivalents.

MODULE-III **(10 Hours)**

State Estimation: Sources of errors inmeasurement, Virtual andPseudo, Measurement, Observability, Tracking stateestimation, WSL method, bad datacorrection.

MODULE-IV **(10 Hours)**

Voltage Stability: Voltagecollapse, P-V curve, multiple power flowsolution, continuation power flow, optimal multiplies loadflow, voltage collapse proximityindices.

Suggested reading

1. J.J. Grainger &W.D. Stevenson, "Power system analysis", McGraw Hill ,2003
2. A. R. Bergen & Vijay Vittal, "Power System Analysis", Pearson ,2000
3. L.P. Singh, "Advanced Power System Analysis and Dynamics", New Age International,2006
4. G.L. Kusic, "Computer aided power system analysis", Prentice Hall India,1986

5. A.J. Wood, “Power generation, operation and control”, John Wiley,1994
6. P.M. Anderson, “Faulted power system analysis”, IEEE Press ,1995

Course outcomes-

Students will be able to:

1. Able to calculate voltage phasors at all buses, given the data using various methods of loadflow.
2. Able to calculate fault currents in eachphase
3. Rank various contingencies according to their severity
4. Estimate the bus voltage phasors given various quantities viz. power flow, voltages, taps, CB status etc
5. Estimate closeness to voltage collapse and calculate PV curves using continuation powerflow

ESE302	Power System Transients	3-0-0	Credits 3

Course Objectives

Students will be able to

1. Learn the reasons for occurrence of transients in a powersystem
2. Understand the change in parameters like voltage & frequency duringtransients
3. Know about the lightning phenomenon and its effect on power system

Syllabus

MODULE-I **(10 Hours)**

Fundamental circuit analysis of electrical transients, Laplace Transform method of solving simple Switching transients, Damping circuits -Abnormal switching transients, Three-phase circuits andtransients, Computation of power system transients. Principle of digital computation –Matrix method of solution, Modal analysis-Ztransform. Computation using EMTP. Lightning, switching and temporary overvoltages. Lightning: Physical phenomena of lightning.

MODULE-II **(10 Hours)**

Interaction between lightning and powersystem, Influence of tower footing resistance and Earth Resistance, Switching: Short line or kilometricfault, Energizing transients - closing and re-closing oflines, Line dropping, loadrejection, Over voltages induced byfaults.

MODULE-III **(11 Hours)**

Switching HVDC line Travelling waves on transmission line: Circuits with distributed Parameters, Wave Equation, Reflection, Refraction. Behaviour of Travelling waves at the lineterminations, Lattice Diagrams – Attenuation and Distortion, Multi-conductor system and Velocitywave.

MODULE-IV **(11 Hours)**

Insulation co-ordination: Principle of insulation co-ordination in Air Insulated substation (AIS) and Gas Insulated Substation (GIS), Co-ordination between insulation and protectionlevel, Statisticalapproach, Protective devices- Protection of system against overvoltages, Lightning arresters, Substation Earthing.

Suggested reading

1. Allan Greenwood, "Electrical Transients in Power System", Wiley & Sons Inc. New York, 1991

Course Outcomes

Students will be ableto

1. Have knowledge of various transients that could occur in power system and their mathematical formulation
2. Have ability to design various protective devices in power system for protecting equipment and personnel
3. Coordinate the insulation of various equipments in power system
4. Model the power system for transient analysis

ESE303	Reliability Analysis and Protection	3-0-0	Credits 3

Course Objectives

Students will be able to

1. Understand proper planning and analysis ofreliability
2. Learn different methods to estimate different electricquantities

Syllabus

MODULE-I **(10 Hours)**

Long and short termplanning, Load forecasting, characteristics ofloads, Methodology of forecasting, energy forecasting, Peak demand forecasting, totalforecasting, Annual and monthly peak demandforecasting.

MODULE-II **(11 Hours)**

Reliability concepts, exponentialdistributions, Meantime to failure, series and parallel system, MARKOV

process, Recursive technique, Generator system reliability analysis, Probability models for generators unit andloads, Reliability analysis of isolated and interconnected system, generator system cost analysis, corporatemodel, Energy transfer and off peakloading.

MODULE-III **(10 Hours)**

Transmission system reliability model analysis: Monte Carlo simulation, Average interruption rate, LOLP method, frequency and duration method.

MODULE-IV **(11 Hours)**

Two plant single loadsystem. Two plant two loadsystem, Load forecasting uncertainly interconnections benefits, Introduction to system modes offailure, The loss of load approach.

Suggested reading

1. Sullivan, R.L., "Power System Planning", HeberHill.
2. Roy Billington, "Power System Reliability Evaluation", Gordan& Breach ScainPublishers.

Course Outcomes

Students will be able to

1. Have knowledge of different methods to estimate different electricalquantities
2. Acquire skills in planning and building reliable powersystem.
3. Manage skills required in the field of power system engineering areenhanced.

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

M.TECH SYLLABUS for *Specialization*: INDUSTRIAL POWER CONTROL AND DRIVES

BRANCH: ELECTRICAL ENGINEERING (2018-19 Admission Batch)

First Semester				Second Semester			
Theory				**Theory**			
Course Code	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**	**Course Code**	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**
	Programme Core-1	3-0-0	3		**Programme Core-3**	3-0-0	3
IPC101	Power Electronics Converters			IPC201	Digital Protection of Power System		
	Programme Core-2	3-0-0	3		**Programme Core-4**	3-0-0	3
IPC102	Power System Analysis			IPC202	Electric Drives System		
	Programme Elective-1 (Any One)	3-0-0	3		**Programme Elective-3 (Any One)**	3-0-0	3
IPE101	Modelling and Analysis of Electrical Machines			IPE201	Advanced Microcontroller based Systems		
IPE102	Optimization Techniques			IPE202	Industrial Load Modelling and Control		
IPE103	Smart Grids			IPE203	FACTS and Custom Power Devices		
	Programme Elective-2 (Any One)	3-0-0	3		**Programme Elective-4 (Any One)**	3-0-0	3
IPE104	Electric and Hybrid Vehicles			IPE204	SCADA System and Applications		
IPE105	Non-Conventional Electrical Energy			IPE205	Power Quality		
IPE106	Advanced Digital Signal Processing			IPE206	Advanced Control System		
GHM101	Research Methodology & Intellectual Property Rights	2-0-0	2		**Audit Course-2 (Any One from the list of Audit Courses)**	2-0-0	0
	Audit Course-1 (Any One from the list of Audit Courses)	2-0-0	0				
	Total (Theory)	**16**	**14**		**Total (Theory)**	**14**	**12**
	Practical/ Sessional				**Practical/ Sessional**		
	Lab-1	0-0-4	2		**Lab-3**	0-0-4	2
IPC103	Power System Lab			IPC203	Electric Drives Lab		
	Lab-2	0-0-4	2		**Lab-4**	0-0-4	2
IPC104	Electrical Machines Laboratory			IPC204	Advance Control System Lab		
				IPJ201	**Mini Project with Seminar**	0-0-4	2
	Total (Practical/ Sessional)	**8**	**4**		**Total (Practical/ Sessional)**	**12**	**6**
	TOTAL	**24**	**18**		**TOTAL**	**26**	**18**
TOTAL SEMESTER CREDITS: 18				TOTAL SEMESTER CREDITS: 18			
TOTAL CUMULATIVE CREDITS: 18				TOTAL CUMULATIVE CREDITS: 36			

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BRANCH: ELECTRICAL ENGINEERING (2018-19 Admission Batch)

Third Semester				Fourth Semester			
Theory				**Theory**			
Course Code	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**	**Course Code**	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**
	Programme Elective-5 (Any One)	3-0-0	3				
IPE301	Power System Transients						
IPE302	Reliability Analysis and Protection						
IPE303	High Voltage DC Transmission						
	Open Elective (Any One)	3-0-0	3				
	Business Analytics						
	Industrial Safety						
	Operations Research						
	Cost Management of Engineering Projects						
	Composite Materials						
	Waste to Energy						
	Internet of Things						
	Soft Computing						
	Project Engineering & Management						
	Start-up & Entrepreneurship Development						
	Total (Theory)	**6**	**6**		**Total (Theory)**	**0**	**0**
	Practical/ Sessional				**Practical/ Sessional**		
IPJ301	Dissertation Phase-I	0-0-20	10	IPJ401	Dissertation Phase-II	0-0-32	16
	Total (Practical/ Sessional)	**20**	**10**		**Total (Practical/ Sessional)**	**32**	**16**
	TOTAL	**26**	**16**		**TOTAL**	**32**	**16**
TOTAL SEMESTER CREDITS: 16				TOTAL SEMESTER CREDITS: 16			
TOTAL CUMULATIVE CREDITS: 52				TOTAL CUMULATIVE CREDITS: 68			

List of Audit courses

1. AHM101 English for Research Paper Writing
2. ACE101 Disaster Management
3. AHM102 Sanskrit for Technical Knowledge
4. AHM103 Value Education
5. AHM104 Constitution of India
6. AHM105 Pedagogy Studies
7. AHM106 Stress Management by Yoga
8. AHM107 Personality Development through Life Enlightenment Skills

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M.TECH SYLLABUS for *Specialization*: INDUSTRIAL POWER CONTROL AND DRIVES

BRANCH: ELECTRICAL ENGINEERING (2018-19 Admission Batch)

1st Semester

IPC101	Power Electronics Converters	3-0-0	Credits 3

Course Objectives:

Students will be able to:

1. Understand the concepts and basic operation of PWM converters, including basic circuit operation and design.
2. Understand the steady-state and dynamic analysis of PWM converters along with theapplications like solid state drives and power quality.

Syllabus

MODULE-I **(12 Hours)**

Analysis of power semiconductor switched circuits with R, L, RL, RC loads, D.C. motor load. Battery charging circuit, Single-Phase and Three-Phase AC to DC converters, Half controlled configurations-operating domains of three phase full converters and semi-converters. Reactive power considerations.

MODULE-II **(10 Hours)**

Analysis and design of DC to DC converters, Control of DC-DC converters: Buck converters, Boost converters, Buck- Boost converters, Cuk converters.

MODULE-III **(10 Hours)**

Single phase and three phase inverters, Voltage source and Current source inverters, Voltage control and harmonic minimization in inverters.

MODULE-IV **(10 Hours)**

AC to AC power conversion using voltage regulators, Choppers and cyclo-converters, Consideration of harmonics, introduction to Matrix converters. Design aspects of converters, Few practical applications.

Suggested reading

1. Ned Mohan, Undeland and Robbin, “Power Electronics: converters, Application and design”, John’s Wiley and sons. Inc, Newyork.
2. M.H. Rashid, “Power Electronics”, Prentice Hall of India1994.

Course Outcomes:

Students will be able to:

1. To give a systematic approach for transient and steady state analysis of all power electronic converters

with passive and active loads.

2. To know and carry out transient and steady state analysis of different power converters of different types of loads and switching sequences.

IPC102	Power System Analysis	3-0-0	Credits 3

Course Objectives-

Students will be able to:

1. Study various methods of load flow and their advantages anddisadvantages
2. Understand how to analyze various types of faults in powersystem
3. Understand power system security concepts and study the methods to rank thecontingencies
4. Understand need of state estimation and study simple algorithms for stateestimation
5. Study voltage instability phenomenon

Syllabus

MODULE-I **(11 Hours)**

Load flow**:** Overview of Newton-Raphson, Gauss-Siedelfast decoupled methods, convergence properties, sparsity techniques, handling Q- max violations in constant matrix, inclusion in frequencyeffects AVR in load flow, handling of discrete variable in loadflow. Fault Analysis**:** Simultaneousfaults, open conductorsfaults, generalized method of faultanalysis.

MODULE-II **(11 Hours)**

Security Analysis: Security state diagram, contingency analysis, generator shift distributionfactorsline outage distribution factor, multiple lineoutages, overload indexranking Power System Equivalents**:** WARD, REI equivalents.

MODULE-III **(10 Hours)**

State Estimation: Sources of errors inmeasurement, Virtual andPseudo, Measurement, Observability, Tracking stateestimation, WSL method, bad datacorrection.

MODULE-IV **(10 Hours)**

Voltage Stability: Voltage collapse, P-V curve, multiple power flowsolution, continuation power flow, optimal multiplies loadflow, voltage collapse proximityindices.

Suggested reading

1. J.J. Grainger &W.D. Stevenson, “Power system analysis”, McGraw Hill ,2003

2. A. R. Bergen & Vijay Vittal, "Power System Analysis" Pearson ,2000
3. L.P. Singh, "Advanced Power System Analysis and Dynamics", New Age International, 2006
4. G.L. Kusic, "Computer aided power system analysis", Prentice Hall India,1986
5. A.J. Wood, "Power generation, operation and control" , John Wiley,1994
6. P.M. Anderson, "Faulted power system analysis", IEEE Press ,1995

Course outcomes-

Students will be able to:

1. Able to calculate voltage phasors at all buses , given the data using various methods of loadflow
2. Able to calculate fault currents in eachphase
3. Rank various contingencies according to their severity
4. Estimate the bus voltage phasors given various quantities viz. power flow, voltages, taps , CB status etc
5. Estimate closeness to voltage collapse and calculate PV curves using continuation powerflow

IPE101	Modelling and Analysis of Electrical Machines	3-0-0	Credits 3

Course Objectives:

Students will be able to:

1. To understand the operation of an electrical machine mathematically.
2. To understand how a machine can be represented as its mathematical equivalent.
3. To develop mathematical model of AC & DC machines and perform transient analysis on them.

Syllabus

MODULE-I **(11 Hours)**

Principles of Electromagnetic Energy Conversion, General expression of stored magnetic energy, Co-energy and force/torque, example using single and doubly excited system. Basic Concepts of Rotating Machines: Calculation of air gap mmfand per phase machine inductance using physical machine data; Voltage and torque equation of dc machine.

MODULE-II **(11 Hours)**

Three phase symmetrical induction machine and salient pole synchronous machines in phase variable form, Application of reference frame theory to three phase symmetrical induction and synchronous machines,

Dynamic direct and quadrature axis model in arbitrarily rotating reference frames.

MODULE-III **(10 Hours)**

Determination of Synchronous machine dynamic equivalent circuit parameters, Analysis and dynamic modeling of two phase asymmetrical induction machine and single phase induction machine.

MODULE-IV **(10 Hours)**

Special Machines - Permanent magnet synchronous machine, Surface permanent magnet (square and sinusoidal back emf type) and interior permanent magnet machines, Construction and operating principle, Dynamic modelling and self-controlled operation, Analysis of Switch Reluctance Motors, Brushless D.C. Motor for space Applications Recent trends.

Suggested reading

1. Charles Kingsle, Jr., A.E. Fitzgerald, Stephen D. Umans, "Electric Machinery", Tata McgrawHill
2. R. Krishnan, "Electric Motor & Drives: Modeling, Analysis and Control", Prentice Hall ofIndia
3. Miller, T.J.E., "Brushless Permanent Magnet and Reluctance Motor Drives", ClarendonPress
4. P.C. Krause "Analysis of Electric Machine" Wiley IEEE Press 3rdEdition

Course Outcomes:

Students will be able to:

1. Knowledge about the dynamic behaviour rotating machines.
2. Able to understand equivalent circuit of synchronous machines.
3. To understand various practical issues of different machines.

IPE102	Optimization Techniques	3-0-0	Credits 3

Course Objectives

Students will be able to

1. Understand the need for optimization and different techniques involved and also constraints.
2. Know Linear/Non-linear Programming.
3. Understand the importance of optimization to solve Engineering problems
4. Know genetic algorithm for Engineering Optimization

Syllabus

MODULE-I **(14 Hours)**

Concepts of optimization: Engineering applications-Statement of optimization problem Classification - type and size of the problem. Classical Optimization Techniques: Single and multi-variable problems- Types of Constraints. Semi definite case saddle point. Linear programming: Standard form. Geometry of LP problems, Theorem of LP- Relation to convexity. Formulation of LP problems, Simplex method and algorithm. Matrix form- two phase method, Duality- dual simplex method. LU Decomposition**.**

MODULE-II **(10 Hours)**

Sensitivity analysis. Artificial variables and complementary solutions-QP. Engineering Applications: Minimum cost flowproblem.Networkproblemstransportation.Assignment&allocation.Scheduling, Karmarkar method-unbalanced and routing problems. Nonlinear programming: Non linearity concepts.

Convex and concave functions. Non-linear programming -gradient and Hessian. Unconstrained optimization: First & Second order necessary conditions. Minimization &Maximization- Local & Global convergence-Speed of convergence**.**

MODULE-III **(10 Hours)**

Basic decent methods: Fibonacci & Golden section search. Gradient methods - Newton Method-Lagrange multiplier method. Kuhn-tucker conditions. Quasi-Newton method- separable convex programming -Frank and Wolfe method. Engineering Applications. Nonlinear programming. Constrained optimization: Characteristics of constraints-Direct methods- SLP, SQP. Indirect methods-Transformation techniques-penalty function. Langrange multiplier methods checking convergence. Engineering applications**.**

MODULE-IV **(8 Hours)**

Dynamic programming: Multistage decision process. Concept of sub optimization and principle of optimality. Computational procedure. Engineering applications. Geneticalgorithms. Simulated Annealing Methods. Optimization programming, tools and Software packages.

Suggested reading

1. David G Luenberger, "Linear and Non Linear Programming", 2nd Ed, Addison-Wesley Pub.Co., Massachusetts,2003
2. W.L. Winston, "Operation Research-Applications & Algorithms",2nd Ed., PWS-KENT Pub. Co., Boston, 2007
3. S.S. Rao, "Engineering Optimization", 3rd Ed. New Age International (P) Ltd, New Delhi,2007
4. W.F. Stocker, "Design of Thermal Systems", 3rd Ed., McGraw Hill, New York.1990
5. G.B. Dantzig, "Linear Programming and Extensions" Princeton University Press, N.J.,1963
6. L.C.W. Dixton, "Non Linear Optimisation: theory and algorithms" Birkhauser, Boston,1980

Course Outcomes

Students will be able to

1. Apply optimization techniques to typical engineering problems
2. Learn the concepts and techniques of nonlinear and unconstrained optimization
3. Acquire knowledge on direct and indirect methods for constrained optimization
4. Learn the application of dynamic programming and genetic algorithms for engineering Optimization

IPE103	Smart Grids	3-0-0	Credits 3

Course Objectives:

Students will be able to:

1. Understand concept of smart grid and its advantages over conventional grid.
2. Know smart metering techniques.
3. Learn wide area measurement techniques.
4. Understanding the problems associated with integration of distributed generation & its solution through smart grid.

Syllabus

MODULE-I **(12 Hours)**

Introduction to Smart Grid. Evolution of Electric Grid. Concept of Smart Grid, Definitions. Need of Smart Grid. Concept of Robust &Self Healing Grid. Present development & International policies in Smart Grid. Introduction to Smart Meters. Real Time Prizing. Smart Appliances. Automatic Meter Reading (AMR). Outage Management System (OMS). Plug in Hybrid Electric Vehicles (PHEV).Vehicle to Grid. Smart Sensors. Home& Building Automation. Smart Substations. Substation Automation. Feeder Automation.

MODULE-II **(8 Hours)**

Geographic Information System (GIS). Intelligent Electronic Devices (IED) & their application for monitoring & protection. Smart storage like Battery. SMES. Pumped Hydro. Compressed Air Energy Storage. Wide Area Measurement System (WAMS). Phase Measurement Unit (PMU).

MODULE-III **(10 Hours)**

Concept of micro-grid. Need & applications of micro-grid. Formation of micro-grid. Issues of Interconnection. Protection & control of micro-grid. Plastic & Organic solar cells. Thin film solar cells. Variable speed wind generators. Fuel-cells. Micro-turbines. Captive power plants. Integration of renewable energy sources.

MODULE-IV **(12 Hours)**

Power Quality & EMC in Smart Grid. Power Quality issues of Grid connected Renewable Energy Sources.

Power Quality Conditioners for Smart Grid. Web based Power Quality monitoring. Power Quality Audit Advanced Metering Infrastructure (AMI). Home Area Network(HAN), Neighborhood Area Network(NAN). Wide Area Network (WAN). Bluetooth. Zig Bee. GPS, Wi-Fi. Wi-Max based communication. Wireless Mesh Network. Basics of CLOUD Computing & Cyber Security for Smart Grid. Broadband over Powerline (BPL). IP based protocols.

Suggested reading

1. Ali Keyhani, "Design of smart power grid renewable energy systems", Wiley IEEE, 2011
2. Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response", CRC Press, 2009
3. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, "Smart Grid: Technology and Applications", Wiley 2012
4. StuartBorlase, "Smart Grid: Infrastructure, Technology and solutions", CRCPress
5. A.G. Phadke, "Synchronized Phasor Measurement and their Applications", Springer

Course Outcomes

Students will be able to

1. Appreciate the difference between smart grid & conventional grid
2. Apply smart metering concepts to industrial and commercial installations
3. Formulate solutions in the areas of smart substations, distributed generation and wide area measurements
4. Come up with smart grid solutions using modern communication technologies

IPE104	Electric and Hybrid Vehicles	3-0-0	Credits 3

Course Objectives:

Students will be able to:

1. To understand upcoming technology of hybridsystem
2. To understand different aspects of drivesapplication learning the electricTraction.

MODULE-I **(11 Hours)**

History of hybrid and electric vehicles, Social and environmental importance of hybrid and electricvehiclesImpact of modern drive-trains on energysupplies, Basics of vehicle performance, vehicle power source characterization Transmissioncharacteristics, models to describe vehicleperformance.

MODULE-II **(11 Hours)**

Basic concept of hybridtraction, Introduction to various hybrid drive-traintopologies, Power flow control in hybrid drive-traintopologies Fuel efficiencyanalysis, Basic concept of hybridtraction, Introductionto various hybrid drive-traintopologies, Power flow control in hybrid drive-traintopologies, Fuel efficiencyanalysis.

MODULE-III **(10 Hours)**

Introduction to electric components used in hybrid and electric vehicle, Configuration and control of DC Motordrives, Configuration and control of Introduction Motor drives configuration and control of Permanent Magnet Motor drives Configuration and control of SwitchReluctance, Motor drives, drive systemefficiency.

MODULE-IV **(10 Hours)**

Matching the electric machine and the internal combustion engine (ICE) Communications, supportingsubsystems, Introduction to energy management and their strategies used in hybrid and electricvehicle Classification of different energy management strategies Comparison of different energy management strategies Implementation issues of energystrategies.

Suggested reading

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
2. MehrdadEhsani, yimiGao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
3. JamesLarminie, John Lowry, Electric vehicle Technology Explained, Wiley 2003.

Course Outcomes: -

Students will be able to:

1. Acquire knowledge about fundamental concepts, principles, analysis and design of hybrid and electricvehicles.
2. To learn electric drive in vehicles /traction.

IPE105	Non-Conventional Electrical Energy	3-0-0	Credits 3

Course Objectives

Students will be able to

1. Understand important concepts of energy generation through non-conventionalways
2. Understand different sources like:- Hydro ,Solar , Biomass, Wind ,Tidal
3. Learn aboutFusion

Syllabus

MODULE-I **(12 Hours)**

Solar energy principles and applications, Efficiency of solar thermal and PV systems, Storage and enrichment, Shadow effect, Biomass: generation characterization.

Biogas: aerobic and anaerobic bio-conversion processes, Microbial reactions purification, Properties of biogas.

MODULE-II **(12 Hours)**

Tidal and wind energy potential and conversion efficiency, Fusion: Basicconcepts, Fusion reaction physics, Thermo nuclear fusion reaction criteria, Confinement schemes, Inertial and magnetic confinement fusion, Current status Geothermal: Geothermal regions, Geothermal sources, Dry rock and hot aquifer analysis Geothermal energy conversion technologies, OTEC.

MODULE-III **(10 Hours)**

Mini/micro hydro power: classification of hydropower schemes, Classification of water turbine, Turbine theory, Essential components of hydroelectric system, System efficiency.

MODULE-IV **(8 Hours)**

Integrated operation of non-conventional energy sources/Islanding preventive schemes.

Suggested reading

1. J. Twidell and T. Weir, "Renewable Energy Resources", Taylor and Francis Group 2007
2. G.N. Tiwari and MK Ghosal, "Renewable Energy Resources Basic Principles and Application", Narosa Publishing House2005.
3. J.A. Duffie and WA Beckman, "Solar Engineering and Thermal Processes", 2nd Edition John Wiley and sons.2001.
4. G.N. Tiwari, "Solar Energy", Narosa Publishing House,2002.
5. R.A. Gross, "Fusion Energy", John Wiley and Sons,1984

Course Outcomes

Students will be able to

1. Have knowledge about Hydro, Wind, Biomass, Tidalsources
2. Learn about Dry rock and Hot AquifierAnalysis
3. Acquire the knowledge aboutfusion

IPE106	Advanced Digital Signal Processing	3-0-0	Credits 3

Course Objectives:

Students will be able to:

1. To understand the difference between discrete-time and continuous-time signals
2. To understand and apply Discrete Fourier Transforms (DFT)

Syllabus

MODULE-I **(12 Hours)**

Discrete time signals, Linear shift invariant systems-Stability and causality, Sampling of continuous time signals-Discrete time Fourier transform- Discrete Fourier series- Discrete Fourier transform, Z transform-Properties of different transforms, Linear convolution using DFT, Computation of DFT Design of IIR digital filters from analog filters, Impulse invariance method, Bilinear transformation method.

MODULE-II **(10 Hours)**

FIR filter design using window functions, Comparison of IIR and FIR digital filters, Basic IIR and FIR filter realization structures, Signal flow graph representations Quantization process and errors, Coefficient quantization effects in IIR and FIR filters.

MODULE-III **(12 Hours)**

A/D conversion noise- Arithmetic round-off errors, Dynamic range scaling, Overflow oscillations and zero-Input limit cycles in IIR filters, Linear Signal Models, All pole, All zero and Pole-zero models, Power spectrum estimation- Spectral analysis of deterministic signals, Estimation of power spectrum of stationary random signals.

MODULE-IV **(8 Hours)**

Optimum linear filters, Optimum signal estimation, Mean square error estimation, Optimum FIR and IIR Filters.

Suggested reading

1. Sanjit KMitra, "Digital Signal Processing: A computer-based approach", TataMc Grow-Hill Edition 1998.
2. Dimitris G. Manolakis, Vinay K. Ingle and Stephen M. Kogon, "Statistical and Adaptive Signal Processing", Mc Grow Hill international editions, 2000.

Course Outcomes:

Students will be able to:

1. Knowledge about the time domain and frequency domain representations as well Analysis of discrete time signals and systems.
2. Study the design techniques for IIR and FIR filters and their realization structures.

3. Acquire knowledge about the finite word length effects in implementation of digital filters.
4. Knowledge about the various linear signal models and estimation of power spectrum of stationary random signals
5. Design of optimum FIR and IIR filters

IPC103	Power System Lab	0-0-4	Credits 2

List of experiments:

1. Introduction to Power System Protection
2. Impact of Induction Motor Starting on Power System
3. Modelling of Differential Relay using MATLAB
4. Radial Feeder Protection
5. Parellel Feeder Protection
6. Principle of Reverse Power Protection
7. Differential Protection of Transformer
8. To the study time vs. voltage characteristics of over voltage induction relay

IPC104	Electrical Machines Laboratory	0-0-4	Credits 2

List of experiments:

1. Load test on dc shunt motor to draw speed – torque and horse power – efficiency characteristics.
2. Field Test on dc series machines.
3. Speed control of dc shunt motor by armature and field control.
4. Swinburne's Test on dc motor.
5. Retardation test on dc shunt motor.
6. Regenerative test on dc shunt machines.
7. Load test on three phase induction motor.
8. No load and Blocked rotor test on three phase induction motor to draw (i) equivalent circuit and (ii) circle diagram. Determination of performance parameters at different load conditions from (i) and (ii).
9. Load test on induction generator.
10. Load test on single phase induction motor to draw output versus torque, current, power and efficiency characteristics.
11. Conduct suitable tests to draw the equivalent circuit of single phase induction motor and determine performance parameters.
12. Conduct an experiment to draw V and inverted V curves of synchronous motor at no load and load conditions.

GHM101	Research Methodology & Intellectual Property Rights	2-0-0	Credits 2

MODULE-I **(06 Hours)**

Meaning of research problem, Sources of research problem, Criteria characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.

Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

MODULE-II **(04 Hours)**

Effective literature studies approaches, analysis,

Plagiarism, Research ethics.

MODULE-III **(04 Hours)**

Effective technical writing, how to write report, Paper.

Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

MODULE-IV **(06 Hours)**

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

MODULE-V **(04 Hours)**

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

MODULE-VI **(04 Hours)**

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Text/Reference Books:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science& engineering students'".
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.

5. Mayall, “Industrial Design”, McGraw Hill, 1992.
6. Niebel, “Product Design”, McGraw Hill, 1974.
7. Asimov, “Introduction to Design”, Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “Intellectual Property in New Technological Age”, 2016.
9. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008

Course Outcomes: At the end of the course, students will be able to

1. Understand research problem formulation.
2. Analyze research related information
3. Follow research ethics
4. Understand that today’s world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property.

   Right to be promoted among students in general & engineering in particular.
6. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Audit Courses

AHM101	English for Research Paper Writing	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Understand that how to improve your writing skills and level of readability
2. Learn about what to write in each section
3. Understand the skills needed when writing a Title

   Ensure the good quality of paper at very first-time submission

MODULE-I **(4 Hours)**

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

MODULE-II **(4 Hours)**

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction.

MODULE-III **(4 Hours)**

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

MODULE-IV **(4 Hours)**

key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed whenwriting a Review of the Literature.

MODULE-V **(4 Hours)**

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions.

MODULE-VI **(4 Hours)**

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

Suggested Studies:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book.

4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

ACE101	Disaster Management	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

MODULE-I **(4 Hours)**

Introduction

Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

MODULE-II **(4 Hours)**

Repercussions of Disasters and Hazards:

Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem.

Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

MODULE-III **(4 Hours)**

Disaster Prone Areas In India

Study of Seismic Zones; Areas Prone To Floods And Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics

MODULE-IV **(4 Hours)**

Disaster Preparedness and Management

Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data From Meteorological and Other Agencies, Media Reports: Governmental and

Community Preparedness.

MODULE-V **(4 Hours)**

Risk Assessment

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategiesfor Survival.

MODULE-VI **(4 Hours)**

Disaster Mitigation

Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India.

Text / Reference Books:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies, NewRoyal book Company.
2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences and Reflections", Prentice Hall OfIndia, New Delhi.
3. Goel S. L., Disaster Administration and Management Text And Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi.

AHM102	Sanskrit for Technical Knowledge	2-0-0	Credits 0

Course Objectives:

1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. Learning of Sanskrit to improve brain functioning
3. Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power
4. The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature

MODULE-I **(8 Hours)**

- Alphabets in Sanskrit
- Past/Present/Future Tense
- Simple Sentences

MODULE-II **(8 Hours)**

- Order
- Introduction of roots
- Technical information about Sanskrit Literature

MODULE-III **(8 Hours)**

- Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

Suggested reading:

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition", Suresh Soni, Ocean books (P) Ltd., New Delhi.

Course Output: Students will be able to

1. Understanding basic Sanskrit language
2. Ancient Sanskrit literature about science & technology can be understood
3. Being a logical language will help to develop logic in students

AHM103	Value Education	2-0-0	Credits 0

Course Objectives: Students will be able to

1. Understand value of education and self- development
2. Imbibe good values in students
3. Know about the importance of character

MODULE-I **(6 Hours)**

- Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism.
- Moral and non- moral valuation. Standards and principles.
- Value judgements

MODULE-II **(6 Hours)**

- Importance of cultivation of values.
- Sense of duty.Devotion, Self-reliance.Confidence, Concentration. Truthfulness, Cleanliness.
- Honesty, Humanity.Power of faith, National Unity.
- Patriotism.Love for nature, Discipline

MODULE-III **(6 Hours)**

- Personality and Behavior Development - Soul and Scientific attitude.
- Positive Thinking. Integrity and discipline.
- Punctuality, Love and Kindness.
- Avoid fault Thinking.
- Free from anger, Dignity of labour.
- Universal brotherhood and religious tolerance.
- True friendship.
- Happiness Vs suffering, love for truth.
- Aware of self-destructive habits.
- Association and Cooperation.
- Doing best for saving nature

MODULE-IV **(6 Hours)**

- Character and Competence –Holy books vs Blind faith.
- Self-management and Good health.
- Science of reincarnation.
- Equality, Nonviolence, Humility, Role of Women.
- All religions and same message.
- Mind your Mind, Self-control.
- Honesty, Studying effectively

Text / Reference Books

1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

Course outcomes: Students will be able to

1. Knowledge of self-development

2. Learn the importance of Human values
3. Developing the overall personality

AHM104	Constitution of India	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutionalrole and entitlement to civil and economic rights as well as the emergence of nationhood inthe early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the BolshevikRevolution in 1917 and its impact on the initial drafting of the Indian Constitution.

MODULE-I **(4 Hours)**

- **History of Making of the Indian Constitution:**

  History

  Drafting Committee, (Composition& Working)

MODULE-II **(4 Hours)**

- **Philosophy of the Indian Constitution:**

  Preamble

  Salient Features

MODULE-III **(4 Hours)**

- **Contours of Constitutional Rights & Duties:**

  Fundamental Rights

  Right to Equality

  Right to Freedom

  Right against Exploitation

  Right to Freedom of Religion

  Cultural and Educational Rights

  Right to Constitutional Remedies

  Directive Principles of State Policy

Fundamental Duties.

MODULE-IV **(4 Hours)**

- **Organs of Governance:**

  Parliament

  Composition

  Qualifications and Disqualifications

  Powers and Functions

  Executive

  President

  Governor

  Council of Ministers

  Judiciary, Appointment and Transfer of Judges, Qualifications

  Powers and Functions

MODULE-V **(4 Hours)**

- **Local Administration:**

  District's Administration head: Role and Importance,

  Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation.

  Pachayati raj: Introduction, PRI: ZilaPachayat.

  Elected officials and their roles, CEO ZilaPachayat: Position and role.

  Block level: Organizational Hierarchy (Different departments),

  Village level: Role of Elected and Appointed officials,

  Importance of grass root democracy

  Model Curriculum of Engineering & Technology PG Courses [Volume -II]

MODULE-VI **(4 Hours)**

- **Election Commission:**

  Election Commission: Role and Functioning.

  Chief Election Commissioner and Election Commissioners.

  State Election Commission: Role and Functioning.

  Institute and Bodies for the welfare of SC/ST/OBC and women.

Text / Reference Books:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Outcomes: Students will be able to:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the passage of the Hindu Code Bill of 1956.

AHM105	Pedagogy Studies	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Review existing evidence on the review topic to inform programme design and policymaking undertaken by the DfID, other agencies and researchers.
2. Identify critical evidence gaps to guide the development.

MODULE-I **(4 Hours)**

- **Introduction and Methodology:**

- Aims and rationale, Policy background, Conceptual framework and terminology
- Theories of learning, Curriculum, Teacher education.
- Conceptual framework, Research questions**.**
- Overview of methodology and Searching.

MODULE-II **(2 Hours)**

- Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries.
- Curriculum, Teacher education.

MODULE-III **(4 Hours)**

- Evidence on the effectiveness of pedagogical practices
- Methodology for the in depth stage: quality assessment of included studies.
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?
- Theory of change.
- Strength and nature of the body of evidence for effective pedagogical practices.
- Pedagogic theory and pedagogical approaches.
- Teachers' attitudes and beliefs and Pedagogic strategies.

MODULE-IV **(4 Hours)**

- Professional development: alignment with classroom practices and follow up support
- Peer support
- Support from the head teacher and the community.
- Curriculum and assessment
- Barriers to learning: limited resources and large class sizes

MODULE-V **(2 Hours)**

- **Research gaps and future directions**
- Research design
- Contexts
- Pedagogy
- Teacher education
- Curriculum and assessment
- Dissemination and research impact.

Text / Reference Books:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2):245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal ofCurriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic

maths and reading in Africa: Does teacher preparation count? International JournalEducational Development, 33 (3): 272–282.

5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

Course outcomes: Students will be able to understand:

1. What pedagogical practices are being used by teachers in formal and informal classrooms indeveloping countries?
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, andwith what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

AHM106	Stress Management by Yoga	2-0-0	Credits 0

Course Objectives:

1. To achieve overall health of body and mind
2. To overcome stress

MODULE-I **(8 Hours)**

- Definitions of Eight parts of yoga. (Ashtanga)

MODULE-II **(8 Hours)**

- Yam and Niyam.

  Do`s and Don't's in life.

  i) Ahinsa, satya, astheya, bramhacharya and aparigraha

  ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

MODULE-III **(8 Hours)**

- Asan and Pranayam

  i) Various yog poses and their benefits for mind & body

  ii) Regularization of breathing techniques and its effects-Types of pranayam

Text / Reference Books:

1. "Yogic Asanas for Group Tarining-Part-I": Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

Course outcomes: Students will be able to:

1. Develop healthy mind in a healthy body thus improving social health also
2. Improve efficiency

AHM107	Personality Development through Life Enlightenment Skills	2-0-0	Credits 0

Course Objectives:

1. To learn to achieve the highest goal happily
2. To become a person with stable mind, pleasing personality and determination
3. To awaken wisdom in students

MODULE-I **(8 Hours)**

Neetisatakam-Holistic development of personality

- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)
- Verses- 52,53,59 (dont's)
- Verses- 71,73,75,78 (do's)

MODULE-II **(8 Hours)**

Approach to day to day work and duties.

- Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48,
- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,
- Chapter 18-Verses 45, 46, 48.

MODULE-III **(8 Hours)**

Statements of basic knowledge.

- Shrimad Bhagwad Geeta: Chapter 2- Verses 56, 62, 68
- Chapter 12 -Verses 13, 14, 15, 16,17, 18
- Personality of Role model. Shrimad Bhagwad Geeta: Chapter 2-Verses 17, Chapter 3-Verses 36,37,42,
- Chapter 4- Verses 18, 38, 39
- Chapter18 – Verses 37, 38, 63

Text / Reference Books:

1. "Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

Course outcomes: Students will be able to:

1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achievethe highest goal in life
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity
3. Study of Neetishatakam will help in developing versatile personality of students.

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

M.TECH SYLLABUS for *Specialization*: INDUSTRIAL POWER CONTROL AND DRIVES

BRANCH: ELECTRICAL ENGINEERING (2018-19 Admission Batch)

2nd Semester

IPC201	Digital Protection of Power System	3-0-0	Credits 3

Course Objectives: - Students will be able to:

1. Study of numericalrelays
2. Developing mathematical approach towards protection
3. Study of algorithms for numericalprotection

Syllabus

MODULE-I **(10 Hours)**

Evolution of digital relays from electromechanicalrelays, Performance and operational characteristics of digitalprotection, Mathematical background to protectionalgorithms

Finite differencetechniques.

MODULE-II **(10 Hours)**

Interpolationformulae, Forward, backward and central differenceinterpolation, Numericaldifferentiation, Curve fitting andsmoothing, Least squaresmethod, Fourieranalysis, Fourier series and Fouriertransform, Walsh functionanalysis.

MODULE-III **(11 Hours)**

Basic elements of digitalprotection, Signal conditioning: transducers, surge protection, analog filtering, analogmultiplexers, Conversion subsystem: the sampling theorem, signalaliasing. Error, sample and hold circuits, multiplexers, analog to digital conversion, Digital filteringconcepts, The digital relay as a unit consisting of hardware andsoftware.

MODULE-IV **(11 Hours)**

Sinusoidal wave basedalgorithms, Sample and first derivative (Mann and Morrison) algorithm. Fourier and Walsh basedalgorithms**,** Fourier Algorithm: Full cycle window algorithm, fractional cycle windowalgorithm, Walsh function based algorithm, Least Squares based algorithms. Differential equation basedalgorithms, Traveling Wave basedTechniques, Digital Differential Protection ofTransformers, Digital Line DifferentialProtection, Recent Advances in Digital Protection of PowerSystems.

Suggested reading

1. A.G. Phadke and J. S. Thorp, "Computer Relaying for Power Systems", Wiley/Research studies Press,2009
2. A.T. Johns and S. K. Salman, "Digital Protection of Power Systems", IEEEPress,1999
3. Gerhard Zeigler, "Numerical Distance Protection", Siemens Publicis Corporate Publishing, 2006 4.S.R. Bhide "Digital Power System Protection" PHI Learning Pvt. Ltd., 2014

Course Outcomes: -

Students will be able to:

1. Learn the importance of DigitalRelays
2. Apply Mathematical approach towardsprotection
3. Learn to develop various Protectionalgorithms

IPC202	Electric Drives System	3-0-0	Credits 3

Course Objectives:

Students will be able to:

1. Understand Basic electrical drives and their analysis.
2. Learn Design of controller for drives.
3. Understand Scalar control of electrical drives.

Syllabus

MODULE-I **(10 Hours)**

Dynamics of Electric Drives: Fundamentals of torque equation, Speed torque convention and Multi-quadrant operation, components of load torques. Classification of load torques steady state stability, Load equation, Speed control and drive classification, close loop control of drives.

MODULE-II **(10 Hours)**

DC motor Drives: Modeling of DC machines, Steady state characteristics with armature and speed control, Phase controlled DC motor drives, chopper controlled DC motor drives.

MODULE-III **(12 Hours)**

Poly-phase induction machines: Dynamic modeling of induction machines, Small signal equations, control characteristics of induction machines, Phase-controlled induction machines, Stator voltage control, Slip energy recovery scheme, frequency control and vector control of induction motor drives.

MODULE-IV **(10 Hours)**

Traction motor: starting, speed-time characteristics, braking, Traction motors used in practice. Industrial Drives: Digital Control of Electric Drives, Stepper motor, Servo motor and their Applications.

Suggested reading

1. G.K, Dubey, "Power semiconductor controlled Drives", Prentice Hall international, New Jersey, 1989.

2. R. Krishanam, “Electric motor drives modeling, analysis and control”, PHI-India-2009.
3. G. K. Dubey, “Fundamentals of electric Drives, Narosa Publishing House”, 2nd edition,2011.
4. W. Leonhard, “Control of Electrical drives”, Springer, 3rd edition, 2001.
5. P.C. Krause –, “Analysis of Electric Machine”, Wiley-IEEE press3rdedition.
6. K. Bose, “Modern Power Electronics and AC Drives”, Prentice Hall publication, 1st edition, 2001.

Course Outcomes:

Students will be able to:

1. Model and simulate electric drive systems
2. Design modulation strategies of power electronics converters, for drives application
3. Design appropriate current/voltage regulators for electric drives
4. Select and implement the drives for Industrial Process Implement various variable speed drives in Electrical Energy Conversion System

IPE201	Advanced Microcontroller based Systems	3-0-0	Credits 3

Course Objectives:

Students will be able to:

1. To understand the architecture of advance microcontrollers
2. To understand the applications of these controllers
3. To get some introduction to FPGA.

Syllabus

MODULE-I **(10 Hours)**

Basic Computer Organization, Accumulator based processes-Architecture-Memory, Organization-I/O Organization.

MODULE-II **(10 Hours)**

Micro-Controllers-Intel 8051, Intel 8056- Registers, Memories, I/O Ports, Serial Communication. Timers, Interrupts, Programming. Intel 8051 – Assembly language programming-Addressing-Operations- Stack &Subroutines, Interrupts-DMA.

MODULE-III **(10 Hours)**

PIC 16F877- Architecture Programming, Interfacing Memory/ I/O Devices, Serial I/O and data communication.

MODULE-IV **(12 Hours)**

Digital signal processor (DSP)- Architecture- Programming, Introduction to FPGA, Microcontroller development for motor control applications, Stepper motor control using microcontroller.

Suggested reading

1. John.F. Wakerly: "Microcomputer Architecture and Programming", John Wiley and Sons1981.
2. Ramesh S. Gaonker: "Microprocessor Architecture, Programming and Applications with the 8085", Penram International Publishing (India), 1994.
3. Raj Kamal: "The Concepts and Features of Microcontrollers", Wheeler Publishing, 2005.
4. Kenneth J. Ayala, "The 8051 microcontroller", Cengage Learning, 2004.
5. John Morton, "The PIC microcontroller: your personal introductory course", Elsevier, 2005.
6. Dogan Ibrahim, "Advanced PIC microcontroller projects in C: from USB to RTOS with the PIC18F Series", Elsevier, 2008.
7. Microchip datasheets for PIC16F877.

Course Outcomes:

Students will be able to:

1. To learn how to program a processor in assembly language and develop an advanced processor based system.
2. To learn configuring and using different peripherals in a digital system.
3. To compile and debug a Program.
4. To generate an executable file and use it.

IPE202	Industrial Load Modelling and Control	3-0-0	Credits 3

Course Objectives:

Students will be able to:

1. To understand the energy demand scenario
2. To understand the modeling of load and its ease to study load demand industrially
3. To know Electricity pricing models
4. Study Reactive power management in Industries

Syllabus

MODULE-I **(10 Hours)**

Electric Energy Scenario-Demand Side Management-Industrial Load Management, Load Curves-Load Shaping Objectives-Methodologies, Barriers; Classification of Industrial, Loads- Continuous and Batch processes -Load Modeling.

MODULE-II **(12 Hours)**

Electricity pricing – Dynamic and spot pricing–Models, Direct load control- Interruptible load control, Bottom up approach- scheduling- Formulation of load models- Optimization and control algorithms – Case studies, Reactive power management in industries-controls-power quality impacts- application of filters Energy saving in industries.

MODULE-III **(12 Hours)**

Cooling and heating loads- load profiling-Modeling, Cool storage-Types- Control strategies, Optimal operation-Problem formulation- Case studies, Captive power units- Operating and control strategies- Power Pooling- Operation models, Energy banking-Industrial Cogeneration.

MODULE-IV **(8 Hours)**

Selection of Schemes Optimal Operating Strategies, Peak load saving-Constraints-Problem formulation- Case study, Integrated Load management for Industries.

Suggested reading

1. C.O. Bjork "Industrial Load Management - Theory, Practice and Simulations", Elsevier, the Netherlands, 1989.
2. C.W. Gellings and S.N. Talukdar, "Load management concepts," IEEE Press, New York, 1986, pp.3-28.
3. Y. Manichaikul and F.C. Schweppe," Physically based Industrial load", IEEE Trans. on PAS, April1981.
4. H. G. Stoll, "Least cost Electricity Utility Planning", Wiley Interscience Publication, USA, 1989.
5. I.J. Nagarath and D.P. Kothari, Modern Power System Engineering., Tata McGraw Hill publishers, New Delhi,1995.
6. IEEE Bronze Book- "Recommended Practice for Energy Conservation and cost effective planningin Industrial facilities", IEEE Inc, USA.

Course Outcomes:

Students will be able to:

1. Knowledge about load control techniques in industries and its application.
2. Different types of industrial processes and optimize the process using tools like LINDO and LINGO.
3. Apply load management to reduce demand of electricity during peak time.
4. Apply different energy saving opportunities in industries.

IPE203	FACTS and Custom Power Devices	3-0-0	Credits 3

Course Objectives:

Students will be able to:

1. To learn the active and reactive power flow control in power system
2. To understand the need for static compensators
3. To develop the different control strategies used for compensation

Syllabus

MODULE-I **(10 Hours)**

Reactive power flow control in Power Systems – Control of dynamic power unbalances in Power System, Power flow control -Constraints of maximum transmission line loading – Benefits of FACTS Transmission line compensation.

Uncompensated line -Shunt compensation - Series compensation–Phase angle control, Reactive power compensation, Shunt and Series compensation principles – Reactive compensation transmission and distribution level.

MODULE-II **(12 Hours)**

Static versus passive VAR compensator, Static shunt compensators: SVC and STATCOM - Operation and control of TSC, TCR and STATCOM – Compensator control, Comparison between SVC and STATCOM, Static series compensation: TSSC, SSSC -Static voltage and phase angle regulators – TCVR and TCPAR Operation and Control –Applications, Static series compensation–GCSC, TSSC, TCSC and Static synchronous series compensators and their Control.

MODULE-III **(9 Hours)**

SSR and its damping Unified Power Flow Controller: Circuit Arrangement, Operation and control of UPF.Basic Principle of P and Q control- Independent real and reactive power flow control-Applications.

MODULE-IV **(10 Hours)**

Introduction to interline power flow controller, Modeling and analysis of FACTS Controllers – Simulation of FACTS controllers Power quality problems in distribution systems, harmonics, Loads that create harmonics, modeling, harmonic propagation, series and parallel resonances, mitigation of harmonics, passive filters, active filtering, shunt, series and hybrid and their control. Voltage swells, sags, flicker, unbalance and mitigation of these problems by power line conditioners- IEEE standards on power quality.

Suggested reading

1. K R Padiyar, "FACTS Controllers in Power Transmission and Distribution", New Age International Publishers, 2007**.**
2. X P Zhang, C Rehtanz, B Pal, "Flexible AC Transmission Systems- Modelling and Control", Springer Verlag, Berlin, 2006.
3. N.G. Hingorani, L. Gyugyi, "Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems", IEEE Press Book, Standard Publishers and Distributors, Delhi, 2001.
4. K.S. Suresh kumar, S. Ashok, "FACTS Controllers & Applications", E-book edition, Nalanda Digital Library, NIT Calicut, 2003.
5. G. T. Heydt, "Power Quality", McGraw-Hill Professional, 2007.
6. T. J. E. Miller, "Static Reactive Power Compensation", John Wiley and Sons, Newyork, 1982.

Course Outcomes:

Students will be able to:

1. Acquire knowledge about the fundamental principles of Passive and Active Reactive Power Compensation Schemes at Transmission and Distribution level in Power Systems.
2. Learn various Static VAR Compensation Schemes like Thyristor /GTO Controlled.
3. Reactive Power Systems, PWM Inverter based Reactive Power Systems and their controls.
4. To develop analytical modeling skills needed for modeling and analysis of such Static VAR Systems.

IPE204	SCADA System and Applications	3-0-0	Credits 3

Course Objectives:

Students will be able to:

1. To understand what is meant by SCADA and its functions.
2. To know SCADA communication.
3. To get an insight into its application.

Syllabus

MODULE-I **(10 Hours)**

Introduction to SCADA: Data acquisition systems, Evolution of SCADA, Communication technologies. Monitoring and supervisory functions, SCADA applications in Utility Automation, Industries SCADA.

MODULE-II **(10 Hours)**

Industries SCADA System Components: Schemes- Remote Terminal Unit (RTU), Intelligent Electronic Devices (IED), Programmable Logic Controller (PLC), Communication Network, SCADA Server, SCADA/HMI Systems.

MODULE-III **(11 Hours)**

SCADA Architecture: Various SCADA architectures, advantages and disadvantages of each system - single unified standard architecture -IEC 61850, SCADA Communication: various industrial communication technologies wired and wireless methods and fiber optics. Open standard communication protocols.

MODULE-IV **(11 Hours)**

SCADA Applications: Utility applications-Transmission and Distribution sector- operations, monitoring, analysis and improvement. Industries - oil, and water. Case studies, Implementation, Simulation Exercises.

Suggested reading

1. Stuart A. Boyer: "SCADA-Supervisory Control and Data Acquisition", Instrument Society of America Publications, USA,2004.
2. Gordon Clarke, Deon Reynders: "Practical Modern SCADA Protocols: DNP3, 60870.5 and RelatedSystems", Newnes Publications, Oxford, UK,2004.
3. William T. Shaw, "Cybersecurity for SCADA systems", PennWell Books,2006.
4. David Bailey, Edwin Wright, "Practical SCADA for industry", Newnes,2003.
5. Wiebe, "A guide to utility automation: AMR, SCADA, and IT systems for electric power", Penn Well1999.

Course Outcomes:

1. Describe the basic tasks of Supervisory Control Systems (SCADA) as well as their typical applications**.**
2. Acquire knowledge about SCADA architecture, various advantages and disadvantages of each system.
3. Knowledge about single unified standard architecture IEC61850.
4. To learn about SCADA system components: remote terminal units, PLCs, intelligent electronic devices, HMI systems, SCADA server.
5. Learn and understand about SCADA applications in transmission and distribution sector, industries etc.

IPE205	Power Quality	3-0-0	Credits 3

Course Objectives:

Students will be able to:

1. Understand the different power quality issues to be addressed
2. Understand the recommended practices by various standard bodies like IEEE, IEC, etc. on voltage & frequency, harmonics
3. Understanding STATIC VAR Compensators

Syllabus

MODULE-I **(12 Hours)**

Introduction-power quality- voltage quality-overview of power, Quality phenomena classification of power quality issues, Power quality measures and standards- THD-TIF-DIN-C-message weights, Flicker factor transient phenomena-occurrence of power quality problems, Power acceptability curves-IEEE guides, Standards and recommended practices. Harmonics- individual and total harmonic distortion, RMS value of a harmonic waveform, Triplex harmonics. Important harmonic introducing devices. SMPS, Three phase power converters-arcing devices saturable devices, Harmonic distortion of fluorescent lamps-effect of power system harmonics on power system equipment and loads.

MODULE-II **(10 Hours)**

Modeling of networks and components under non-sinusoidal conditions, Transmission and distribution systems, Shunt capacitors-transformers, Electric machines, Ground systems loads that cause power quality problems, Power quality problems created by drives and its impact on drive.

MODULE-III **(10 Hours)**

Power factor improvement- Passive Compensation, Passive Filtering. Harmonic Resonance. Impedance Scan Analysis, Active Power Factor Corrected Single Phase Front End, Control Methods for Single Phase APFC, Three Phase APFC and Control Techniques, PFC based on Bilateral Single Phase and Three Phase Converter.

MODULE-IV **(10 Hours)**

Hamilton-Jacobi-Bellman model reference adaptive systems Equation (MRAS) – Design hypothesis

Introduction to design method based on the use of Liapunov function, Design and simulation of variable structure adaptive model following control.

Suggested reading

1. G.T. Heydt, “Electric power quality”, McGraw-Hill Professional,2007
2. Math H. Bollen, “Understanding Power Quality Problems”, IEEE Press,2000
3. J. Arrillaga, “Power System Quality Assessment”, John wiley,2000
4. J. Arrillaga, B.C. Smith, N.R. Watson &A. R.Wood ,”Power system Harmonic Analysis”, Wiley, 1997.

Course Outcomes:

Students will be able to:

1. Acquire knowledge about the harmonics, harmonic introducing devices and effect of harmonics on system equipment and loads
2. Develop analytical modeling skills needed for modeling and analysis of harmonics in networks and components
3. To introduce the student to active power factor correction based on static VAR compensators and its

control techniques

4. To introduce the student to series and shunt active power filtering techniques for harmonics.

IPE206	Advanced Control System	3-0-0	Credits 3

Course Objectives

1. The course provides glimpses into the advanced methods of modeling and analysis ofthe dynamicalsystems.
2. The course is a strong step in inculcating the research aptitude in thestudents.

MODULE-I **(11 Hours)**

Math Modelling of Dynamical Systems: Newtonian and Lagrangian approaches, Concept of dynamical state of a system, Concept of equilibrium point, linearization of non-linearmodel. Review of Linear Algebra concepts: Field, Vector space, linear combination, linear independence, bases of a vectorspace, representation of any vector on different basis, matrix representation of a linear operator, change of basis, rank, nullity, range space and null space ofa matrix, Eigen value and Eigen vector of a matrix, similarity transform, Diagonalisation.

MODULE-II **(11 Hours)**

Modern Control Analysis: Concept and computation of systemsmodes, controllability theorem and itsproof, Observability theorem and itsproof, Controllable and observablesubspaces. Stability Analysis: Stability of linear systems, stabilitytypes and their definitions for any generalsystem, Stability of an equilibrium point, Lyapunov stability theory for LTIsystems, Quadratic forms and Lyapunovfunctions.

MODULE-III **(10 Hours)**

Modern Control Design: Converting the math model to controllable canonical form and its use for poleplacement, Concept of linear observer and itsdesign, Design of reduced orderobserver, Compensator design using separationprinciple, Poles ofcompensator, Open loop and close-loopsystems.

MODULE-IV **(10 Hours)**

Optimal Control Theory: Introduction to the philosophy of optimalcontrol, formulation of optimal control problem, different performancecriterion, Linear quadratic regulator (LQR) and optimum gainmatrix, Riccati equations, conceptual models and statistical models for random processes, Kalmanfilter.

Suggested reading

1. Bernard Friedland, "Control System Design: An Introduction to State-Space Methods", Dover Publications, Inc. Mineola, New York,2012

2. Thomas Kailath, “Linear Systems”, Prentice-Hall Inc., New Jersey,1986
3. M. Gopal, “Modern Control System Theory”, , New Age International (P) Limited, New Delhi, 2000

Course Outcomes

Students will be able to

1. Apply the concepts of linear algebra and their applications to controlsystem
2. Analyze the system dynamics and Lyapunov stabilitytheory
3. Design linear quadraticcontroller

IPC203	Electric Drives Lab	0-0-4	Credits 2

List of experiments:

1. Study of Thyristor controlled D.C Drive.
2. Study of Chopper Fed DC Motor.
3. Study of A.C single phase motor speed control using TRIAC.
4. PWM inverter fed three phase induction motor control using PSPICE/MATLAB/PSIM software.
5. VSI/CSI fed induction motor drive analysis using MATLAB/PSPICE/PSIM software.
6. Study of V/f control operation of three phase induction motor.
7. Study of permanent magnet synchronous motor drive fed by PWM inverter using software.
8. Regenerative/ Dynamic breaking operation for DC motor study using software.
9. Regenerative/ Dynamic breaking operation for AC motor study using software.
10. PC/PLC based AC/DC motor control operation.

IPC204	Advance Control System Lab	0-0-4	Credits 2

List of experiments:

1. State space modeling of discrete time systems and study of responses.
2. Pole placement design for regulator and tracking discrete time systems.
3. Observer design for discrete time systems
4. Design of digital kalman filter
5. Optimal control design of digital systems
6. Analysis of non linear systems using describing function method
7. Phase plane analysis of non linear systems.

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

M.TECH SYLLABUS for *Specialization*: INDUSTRIAL POWER CONTROL AND DRIVES

BRANCH: ELECTRICAL ENGINEERING (2018-19 Admission Batch)

3rd Semester

IPE301	Power System Transients	3-0-0	Credits 3

Course Objectives

Students will be able to

1. Learn the reasons for occurrence of transients in a powersystem
2. Understand the change in parameters like voltage & frequency duringtransients
3. Know about the lightning phenomenon and its effect on powersystem

Syllabus

MODULE-I **(10 Hours)**

Fundamental circuit analysis of electricaltransients, Laplace Transform method of solving simple Switchingtransients, Damping circuits -Abnormal switchingtransients, Three-phase circuits andtransients, Computation of power systemtransients. Principle of digital computation –Matrix method ofsolution, Modal analysis- Ztransform. Computation using EMTP. Lightning, switching and temporary overvoltages. Lightning: Physical phenomena oflightning.

MODULE-II **(10 Hours)**

Interaction between lightning and powersystem, Influence of tower footing resistance and Earth Resistance, Switching: Short line or kilometricfault, Energizing transients - closing and re-closing oflines, Line dropping, loadrejection, Over voltages induced byfaults.

MODULE-III **(11 Hours)**

Switching HVDC line Travelling waves on transmission line: Circuits with distributedParameters, Wave Equation, Reflection, Refraction. Behaviour of Travelling waves at the lineterminations, Lattice Diagrams – Attenuation andDistortion, Multi-conductor system and Velocitywave.

MODULE-IV **(11 Hours)**

Insulation co-ordination: Principle of insulation co-ordination in Air Insulated substation (AIS) and Gas Insulated Substation (GIS), Co-ordination between insulation and protectionlevel, Statisticalapproach, Protective devices- Protection of system against overvoltages, Lightningarresters, Substation Earthing.

Suggested reading

1. Allan Greenwood, “Electrical Transients in Power System”, Wiley & Sons Inc. New York, 1991

Course Outcomes

Students will be ableto

1. Have knowledge of various transients that could occur in power system and their mathematicalformulation
2. Have ability to design various protective devices in power system for protecting equipment and personnel
3. Coordinate the insulation of various equipments in power system
4. Model the power system for transient analysis

IPE302	Reliability Analysis and Protection	3-0-0	Credits 3

Course Objectives

Students will be able to

1. Understand proper planning and analysis ofreliability
2. Learn different methods to estimate different electricquantities

Syllabus

MODULE-I **(10 Hours)**

Long and short termplanning, Load forecasting, characteristics ofloads, Methodologyof forecasting, energyforecasting, Peak demand forecasting, totalforecasting, Annual and monthly peak demandforecasting.

MODULE-II **(11 Hours)**

Reliability concepts, exponentialdistributions, Meantime to failure, series and parallel system, MARKOV process, Recursive technique, Generator system reliability analysis, Probability models for generators unit andloads, Reliability analysis of isolated and interconnected system, generator system cost analysis, corporatemodel, Energy transfer and off peakloading.

MODULE-III **(10 Hours)**

Transmission system reliability model analysis: Monte Carlo simulation, Average interruptionrate, LOLP method, frequency and durationmethod.

MODULE-IV **(11 Hours)**

Two plant single loadsystem. Two plant two loadsystem, Load forecasting uncertainly interconnectionsbenefits, Introduction to system modes offailure, The loss of load approach.

Suggested reading

1. Sullivan, R.L., "Power System Planning", HeberHill.
2. Roy Billington, "Power System Reliability Evaluation", Gordan& Breach ScainPublishers.

Course Outcomes

Students will be able to

1. Have knowledge of different methods to estimate different electricalquantities
2. Acquire skills in planning and building reliable powersystem.
3. Manage skills required in the field of power system engineering areenhanced.

IPE303	High Voltage DC Transmission	3-0-0	Credits 3

Course Objectives:

Students will be able to:

1. Understand state of the art HVDC technology.
2. Learn the Methods to carry out modeling and analysis of HVDC system frontier-area power flow regulation.

Syllabus

MODULE-I **(11 Hours)**

Development of HVDC Technology, DC versus AC Transmission, Selection of converter configuration. Rectifier and Inverter operation, Digital Simulation of converters, Control of HVDC converters and Systems.

MODULE-II **(10 Hours)**

Individual phase control, Equidistant firing controls, Higher level controls. Characteristics and non-characteristics harmonics filter design. Fault development and protection.

MODULE-III **(11 Hours)**

Interaction between AC-DC power systems. Over voltages on AC/DC side, multi-terminal HVDC systems, control of MTDC systems, Modelling of HVDC systems, per unit system, Representation for power flow solution, representation for stability studies.

MODULE-IV **(10 Hours)**

Introduction to relevant national and international standards, safe clearancesforHV, Study regulations for HV tests, Digital techniques in HV measurements.

Suggested reading

1. J. Arrillaga, “High Voltage Direct Transmission”, Peter Peregrinus Ltd. London,1983.
2. K. R. Padiyar, “HVDC Power Transmission Systems”, Wiley Eastern Ltd.,1990.
3. E. W. Kimbark, “Direct Current Transmission”, Vol. I, Wiley Interscience,1971.
4. Erich Uhlmann, “Power Transmission by Direct Current”, B.S. Publications,2004.

Course Outcomes:

Students will be able to:

1. To expose the students to the state of the art HVDC technology.
2. Knowledge of modelling and analysis of HVDC system for inter-area power flow regulation.

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

M.TECH SYLLABUS for *Specialization*: POWER ELECTRONICS AND DRIVES

BRANCH: ELECTRICAL ENGINEERING (2018-19 Admission Batch)

First Semester				Second Semester			
Theory				**Theory**			
Course Code	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**	**Course Code**	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**
	Programme Core-1	3-0-0	3		**Programme Core-3**	3-0-0	3
PEC101	Power Electronics Converters			PEC201	Electric Drives System		
	Programme Core-2	3-0-0	3		**Programme Core-4**	3-0-0	3
PEC102	Modeling and Analysis of Electrical Machines			PEC202	Digital Control of Power Electronic and Drive Systems		
	Programme Elective-1 (Any One)	3-0-0	3		**Programme Elective-3 (Any One)**	3-0-0	3
PEE101	Industrial Load Modeling and Control			PEE201	Switched Mode and Resonant Converters		
PEE102	Optimal and Adaptive Control			PEE202	Advanced Power Electronic Circuits		
PEE103	Power Quality			PEE203	Advanced Digital Signal Processing		
	Programme Elective-2 (Any One)	3-0-0	3		**Programme Elective-4 (Any One)**	3-0-0	3
PEE104	Static VAR Controllers and Harmonic Filtering			PEE204	Advanced Microcontroller based Systems		
PEE105	PWM converter and Applications			PEE205	Distributed Generation		
PEE106	Power Semiconductor Devices & Modeling			PEE206	Smart Grids		
GHM101	Research Methodology & Intellectual Property Rights	2-0-0	2		**Audit Course-2 (Any One from the list of Audit Courses)**	2-0-0	0
	Audit Course-1 (Any One from the list of Audit Courses)	2-0-0	0				
	Total (Theory)	**16**	**14**		**Total (Theory)**	**14**	**12**
	Practical/ Sessional				**Practical/ Sessional**		
	Lab-1	0-0-4	2		**Lab-3**	0-0-4	2
PEC103	Power Electronics Laboratory			PEC203	Electrical Drives Laboratory		
	Lab-2	0-0-4	2		**Lab-4**	0-0-4	2
PEC104	Electrical Machines Laboratory			PEC204	Digital Signal Processing Lab		
				PEJ201	**Mini Project with Seminar**	0-0-4	2
	Total (Practical/ Sessional)	**8**	**4**		**Total (Practical/ Sessional)**	**12**	**6**
	TOTAL	**24**	**18**		**TOTAL**	**26**	**18**
TOTAL SEMESTER CREDITS: 18				TOTAL SEMESTER CREDITS: 18			
TOTAL CUMULATIVE CREDITS: 18				TOTAL CUMULATIVE CREDITS: 36			

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

M.TECH SYLLABUS for *Specialization*: POWER ELECTRONICS AND DRIVES

BRANCH: ELECTRICAL ENGINEERING (2018-19 Admission Batch)

Third Semester				Fourth Semester			
Theory				**Theory**			
Course Code	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**	**Course Code**	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**
	Programme Elective-5 (Any One)	3-0-0	3				
PEE301	SCADA Systems and Applications						
PEE302	FACTS and Custom Power Devices						
PEE303	High Voltage DC Transmission						
PEE304	Advanced Electric Drives						
	Open Elective (Any One) Business Analytics Industrial Safety Operations Research Cost Management of Engineering Projects Composite Materials Waste to Energy Internet of Things Soft Computing Project Engineering & Management Start-up & Entrepreneurship Development	3-0-0	3				
	Total (Theory)	**6**	**6**		**Total (Theory)**	**0**	**0**
	Practical/ Sessional				**Practical/ Sessional**		
PEJ301	Dissertation Phase-I	0-0-20	10	PEJ401	Dissertation Phase-II	0-0-32	16
	Total (Practical/ Sessional)	**20**	**10**		**Total (Practical/ Sessional)**	**32**	**16**
	TOTAL	**26**	**16**		**TOTAL**	**32**	**16**
TOTAL SEMESTER CREDITS: 16				TOTAL SEMESTER CREDITS: 16			
TOTAL CUMULATIVE CREDITS: 52				TOTAL CUMULATIVE CREDITS: 68			

List of Audit courses

1. AHM101 English for Research Paper Writing
2. ACE101 Disaster Management
3. AHM102 Sanskrit for Technical Knowledge
4. AHM103 Value Education
5. AHM104 Constitution of India
6. AHM105 Pedagogy Studies
7. AHM106 Stress Management by Yoga
8. AHM107 Personality Development through Life Enlightenment Skills

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

M.TECH SYLLABUS for *Specialization*: POWER ELECTRONICS AND DRIVES

BRANCH: ELECTRICAL ENGINEERING (2018-19 Admission Batch)

1st Semester

PEC101	Power Electronics Converters	3-0-0	Credits 3

Course Objectives:

Students will be able to:

1. Understand the concepts and basic operation of PWM converters, including basic circuit operation and design.
2. Understand the steady-state and dynamic analysis of PWM converters along with theapplications like solid state drives and power quality.

Syllabus

MODULE-I **(12 Hours)**

Analysis of power semiconductor switched circuits with R, L, RL, RC loads, D.C. motor load. Battery charging circuit, Single-Phase and Three-Phase AC to DC converters, Half controlled configurations-operating domains of three phase full converters and semi-converters. Reactive power considerations.

MODULE-II **(10 Hours)**

Analysis and design of DC to DC converters, Control of DC-DC converters: Buck converters, Boost converters, Buck- Boost converters, Cuk converters.

MODULE-III **(10 Hours)**

Single phase and three phase inverters, Voltage source and Current source inverters, Voltage control and harmonic minimization in inverters.

MODULE-IV **(10 Hours)**

AC to AC power conversion using voltage regulators, Choppers and cyclo-converters, Consideration of harmonics, introduction to Matrix converters. Design aspects of converters, Few practical applications.

Suggested reading

1. Ned Mohan, Undeland and Robbin, "Power Electronics: converters, Application and design", John's Wiley and sons. Inc, Newyork.
2. M.H. Rashid, "Power Electronics", Prentice Hall of India1994.

Course Outcomes:

Students will be able to:

1. To give a systematic approach for transient and steady state analysis of all power electronic converters

with passive and active loads.

2. To know and carry out transient and steady state analysis of different power converters of different types of loads and switching sequences.

PEC102	Modeling and Analysis of Electrical Machines	3-0-0	Credits 3

Course Objectives:

Students will be able to:

1. To understand the operation of an electrical machine mathematically.
2. To understand how a machine can be represented as its mathematical equivalent.
3. To develop mathematical model of AC & DC machines and perform transient analysis on them.

Syllabus

MODULE-I **(11 Hours)**

Principles of Electromagnetic Energy Conversion, General expression of stored magnetic energy, Co-energy and force/torque, example using single and doubly excited system. Basic Concepts of Rotating Machines: Calculation of air gap mmfand per phase machine inductance using physical machine data; Voltage and torque equation of dc machine.

MODULE-II **(11 Hours)**

Three phase symmetrical induction machine and salient pole synchronous machines in phase variable form, Application of reference frame theory to three phase symmetrical induction and synchronous machines, Dynamic direct and quadrature axis model in arbitrarily rotating reference frames.

MODULE-III **(8 Hours)**

Determination of Synchronous machine dynamic equivalent circuit parameters, Analysis and dynamic modeling of two phase asymmetrical induction machine and single phase induction machine.

MODULE-IV **(12 Hours)**

Special Machines - Permanent magnet synchronous machine, Surface permanent magnet (square and sinusoidal back emf type) and interior permanent magnet machines, Construction and operating principle, Dynamic modelling and self-controlled operation, Analysis of Switch Reluctance Motors, Brushless D.C. Motor for space Applications Recent trends.

Suggested reading

1. Charles Kingsle, Jr., A.E. Fitzgerald, Stephen D. Umans, “Electric Machinery”, Tata McgrawHill
2. R. Krishnan, “Electric Motor & Drives: Modeling, Analysis and Control”, Prentice Hall ofIndia

3. Miller, T.J.E., "Brushless Permanent Magnet and Reluctance Motor Drives", ClarendonPress
4. P.C. Krause "Analysis of Electric Machine" Wiley IEEE Press 3rd Edition

Course Outcomes:

Students will be able to:

1. Knowledge about the dynamic behavior rotating machines.
2. Able to understand equivalent circuit of synchronous machines.
3. To understand various practical issues of different machine

PEE101	Industrial Load Modeling and Control	3-0-0	Credits 3

Course Objectives:

1. Students will be able to:
2. To understand the energy demand scenario
3. To understand the modeling of load and its ease to study load demand industrially
4. To know Electricity pricing models
5. Study Reactive power management in Industries

MODULE-I **(10 Hours)**

Electric Energy Scenario-Demand Side Management-Industrial Load Management, Load Curves-Load Shaping Objectives-Methodologies, Barriers; Classification of Industrial, Loads- Continuous and Batch processes -Load Modeling.

MODULE-II **(12 Hours)**

Electricity pricing – Dynamic and spot pricing–Models, Direct load control- Interruptible load control, Bottom up approach- scheduling- Formulation of load models- Optimization and control algorithms – Case studies, Reactive power management in industries-controls-power quality impacts- application of filters Energy saving in industries.

MODULE-III **(12 Hours)**

Cooling and heating loads- load profiling-Modeling, Cool storage-Types- Control strategies, Optimal operation-Problem formulation- Case studies, Captive power units- Operating and control strategies- Power Pooling- Operation models, Energy banking-Industrial Cogeneration.

MODULE-IV **(8 Hours)**

Selection of Schemes Optimal Operating Strategies, Peak load saving-Constraints-Problem formulation- Case study, Integrated Load management for Industries.

Suggested reading

1. C.O. Bjork "Industrial Load Management - Theory, Practice and Simulations", Elsevier, the Netherlands, 1989.
2. C.W. Gellings and S.N. Talukdar, "Load management concepts," IEEE Press, New York, 1986, pp.3-28.
3. Y. Manichaikul and F.C. Schweppe," Physically based Industrial load", IEEE Trans. on PAS, April1981.
4. H. G. Stoll, "Least cost Electricity Utility Planning", Wiley Interscience Publication, USA,1989.
5. I.J. Nagarath and D.P. Kothari, Modern Power System Engineering., Tata McGraw Hill publishers, New Delhi,1995.
6. IEEE Bronze Book- "Recommended Practice for Energy Conservation and cost effective planningin Industrial facilities", IEEE Inc, USA.

Course Outcomes:

Students will be able to:

1. Knowledge about load control techniques in industries and its application.
2. Different types of industrial processes and optimize the process using tools like LINDO and LINGO.
3. Apply load management to reduce demand of electricity during peak time.
4. Apply different energy saving opportunities in industries.

PEE102	Optimal and Adaptive Control	3-0-0	Credits 3

Course Objectives:

Students will be able to:

1. To know the operation of closed and open loop optimal control.
2. Understand the adaptive control strategies.
3. Learn dynamic programming method.

MODULE-I **(14 Hours)**

Optimal control problem – fundamental concepts and theorems of calculus of variations–Euler - Language equation and extremalof functional, Various approaches to solving optimal control problems, Hamiltonian and different boundary conditions for optimal control problem.

MODULE-II **(10 Hours)**

Linear regulator problem - Pontryagin's minimum principle, Dynamic programming - Principle of optimality

and its application to optimal control problem.

MODULE-III **(8 Hours)**

Hamilton-Jacobi-Bellman equation - model reference adaptive systems (MRAS) – Design hypothesis

MODULE-IV **(8 Hours)**

Introduction to design method based on the use of Liapunov function, Design and simulation of variable structure adaptive model following control.

Suggested reading

1. Donald E. Kirk, "Optimal Control Theory, An introduction", Prentice Hall Inc.,2004.
2. A.P. Sage, "Optimum Systems Control", Prentice Hall, 1977.
3. HSU and Meyer, "Modern Control, Principles and Applications", McGraw Hill, 1968.
4. Yoan D. Landu, "Adaptive Control (Model Reference Approach)", Marcel Dekker.1981
5. K.K.D. Young, "Design of Variable Structure Model Following Control Systems", IEEE Transactions on Automatic Control, Vol. 23, pp 1079-1085,1978.

Course Outcomes:

Students will be able to:

1. Knowledge in the mathematical area of calculus of variation so as to apply the same for solving optimal control problems.
2. Problem formulation, performance measure and mathematical treatment of optimal control problems.
3. Acquire knowledge on solving optimal control design problems by taking into consideration the physical constraints on practical control systems.
4. To obtain optimal solutions to controller design problems taking into consideration the limitation on control energy in the real practical world.

PEE103	Power Quality	3-0-0	Credits 3

Course Objectives:

Students will be able to:

1. Understand the different power quality issues to be addressed
2. Understand the recommended practices by various standard bodies like IEEE, IEC, etc. on voltage & frequency, harmonics
3. Understanding STATIC VAR Compensators

MODULE-I **(12 Hours)**

Introduction-power quality- voltage quality-overview of power, Quality phenomena classification of power quality issues, Power quality measures and standards- THD-TIF-DIN-C-message weights, Flicker factor transient phenomena-occurrence of power quality problems, Power acceptability curves-IEEE guides, Standards and recommended practices. Harmonics- individual and total harmonic distortion, RMS value of a harmonic waveform, Triplex harmonics. Important harmonic introducing devices. SMPS, Three phase power converters-arcing devices saturable devices, Harmonic distortion of fluorescent lamps-effect of power system harmonics on power system equipment and loads.

MODULE-II **(10 Hours)**

Modeling of networks and components under non-sinusoidal conditions, Transmission and distribution systems, Shunt capacitors-transformers, Electric machines, Ground systems loads that cause power quality problems, Power quality problems created by drives and its impact on drive.

MODULE-III **(10 Hours)**

Power factor improvement- Passive Compensation, Passive Filtering. Harmonic Resonance. Impedance Scan Analysis, Active Power Factor Corrected Single Phase Front End, Control Methods for Single Phase APFC, Three Phase APFC and Control Techniques, PFC based on Bilateral Single Phase and Three Phase Converter.

MODULE-IV **(10 Hours)**

Hamilton-Jacobi-Bellman equation (MRAS) – Design hypothesis. Model reference adaptive systems.

Introduction to design method based on the use of Liapunov function, Design and simulation of variable structure adaptive model following control.

Suggested reading

1. G.T. Heydt, “Electric power quality”, McGraw-Hill Professional, 2007.
2. Math H. Bollen, “Understanding Power Quality Problems”, IEEE Press, 2000.
3. J. Arrillaga, “Power System Quality Assessment”, John wiley, 2000.
4. J. Arrillaga, B.C. Smith, N.R. Watson &A. R.Wood ,”Power system Harmonic Analysis”, Wiley, 1997.

Course Outcomes:

Students will be able to:

1. Acquire knowledge about the harmonics, harmonic introducing devices and effect of harmonics on system equipment and loads
2. develop analytical modeling skills needed for modeling and analysis of harmonics in networks and components
3. To introduce the student to active power factor correction based on static VAR compensators and its control techniques
4. To introduce the student to series and shunt active power filtering techniques for harmonics.

PEE104	Static VAR Controllers and Harmonic Filtering	3-0-0	Credits 3

Course Objectives:

Students will be able to:

1. Understand the various static converters
2. Understand the static converter control strategies
3. Understand the active and reactive power compensation and their control
4. Understand harmonic filtering and its control design.

MODULE-I **(12 Hours)**

Fundamentals of LoadCompensation, Steady-State Reactive Power Control in Electric TransmissionSystems, Reactive Power CompensationandDynamic Performance of TransmissionSystems, Power Quality Issues: Sags, Swells, Unbalance, Flicker, Distortion, Current Harmonics.Sources of Harmonics in Distribution Systems and Ill Effects.

MODULE-II **(10 Hours)**

Static Reactive Power Compensators and their control, Shunt Compensators, SVCs of Thyristor Switched and Thyristor Controlled types and their control, STATCOMs and their control, Series Compensators of thyristor Switched and Controlled Type and their Control, SSSC and its Control, Sub-Synchronous Resonance and damping, Use of STATCOMs and SSSCs for Transient and Dynamic Stability Improvement in Power System.

MODULE-III **(10 Hours)**

Converters for Static Compensation, Single Phase and Three Phase Converters and Standard Modulation Strategies (Programmed Harmonic Elimination and SPWM), GTO Inverters. Multi-Pulse Converters and Interface Magnetics, Multi-Level Inverters of Diode Clamped Type and Flying Capacitor Type and suitable modulation strategies (includes SVM), Multi-level inverters of Cascade Type and their modulation. Current Control of Inverters.

MODULE-IV **(10 Hours)**

Passive Harmonic Filtering, Single Phase Shunt Current Injection Type Filter and its Control, Three Phase Three-wire Shunt Active Filtering and their control using p-q theory and d-q modeling, Three phase four wire shunt active filters, Hybrid Filtering using Shunt Active Filters, Dynamic Voltage Restorer and its control, Power Quality Conditioner**,** Series Active Filtering in Harmonic Cancellation Mode, Series Active Filtering in Harmonic Isolation Mode.

Suggested reading

1. Ned Mohan et.al, "Power Electronics", John Wiley andSons, 2006.
2. G. Massobrio, P. Antognet," Semiconductor Device Modeling with Spice", McGraw-Hill, Inc., 1988.

3. B. J. Baliga," Power Semiconductor Devices", Thomson, 2004
4. V. Benda, J. Gowar, D. A.Grant, "Power Semiconductor Devices. Theory and Applications", JohnWiley & Sons1994.

Course Outcomes

Students will be able to:

1. Acquire knowledge about the fundamental principles of Passive and Active Reactive Power Compensation Schemes at Transmission and Distribution level in Power Systems.
2. To introduce the student to various single phase and three-phase Static VAR Compensation schemes and their controls
3. To develop analytical modeling skills needed for modeling and analysis of such Static VAR

PEE105	PWM converter and Applications	3-0-0	Credits 3

Course Objectives:

Students will be able to:

1. Understand the concepts and basic operation of PWM converters, including basic circuit operation and design.
2. Understand the steady-state and dynamic analysis of PWM converters along with the applications like solid state drives and power quality.

MODULE-I **(10 Hours)**

AC/DC and DC/AC power conversion, Overview of applications of voltage source converters and current source converters.

MODULE-II **(10 Hours)**

Pulse width modulation techniques for bridge converters, Bus clamping PWM, Space vector based PWM, Advanced PWM techniques, Practical devices in converter, Calculation of switching and conduction power losses.

MODULE-III **(10 Hours)**

Compensation for dead time and DC voltage regulation, Dynamic model of PWM converter, Multilevel converters, Constant V/F induction motor drives.

MODULE-IV **(12 Hours)**

Estimation of current ripple and torque ripple in inverter fed drives, Line-side converters with power factor compensation, Active power filtering, Reactive power compensation, Harmonic current compensation,

Selective harmonic elimination PWM technique for high power electric drives.

Suggested reading

1. Mohan, Undeland and Robbins, "Power Electronics: Converters, Applications and Design", John's Wiley andSons.
2. Erickson RW, "Fundamentals of Power Electronics", Chapman andHall.
3. Vithyathil. J, "Power Electronics: Principles and Applications", McGrawHill.

Course Outcomes:

Students will be able to:

1. Knowledge concepts and basic operation of PWM converters, including basic circuit operation and design
2. Learn the steady-state and dynamic analysis of PWM converters along with the applications like solid state drives and power quality
3. Able to recognize and use the following concepts and ideas: Steady-State and transient modelling and analysis of power converters with various PWM techniques.

PEE106	Power Semiconductor Devices & Modeling	3-0-0	Credits 3

Course Objectives:

Students will be able to:

1. Understand the concepts and basic operation of PWM converters, including basic circuit operation and design
2. Understand the steady-state and dynamic analysis of PWM converters along with the applications like solid state drives and power quality

MODULE-I **(8 Hours)**

Energy auditing: Types and objectives, Audit instruments- ECO assessment and Economic methods specific energy analysis, Minimum energy paths-consumption models-Case study.

MODULE-II **(12 Hours)**

Electric Motors-Energy efficient controls and starting Efficiency, Motor Efficiency and Load Analysis, Energy efficient /high efficient Motors-Case study, Load Matching and selection of motors. Variable speed drives, Pumps and Fans-Efficient Control strategies, Optimal selection and sizing, Optimal operation and Storage: Case study, Transformer Loading/Efficiency analysis, Feeder/cable loss evaluation: Case study, Reactive Power Management, Capacitor Sizing-Degree of compensation, Capacitor losses-Location-Placement Maintenance, Case study.

MODULE-III **(11 Hours)**

Peak Demand controls-Methodologies, Types of Industrial loads-Optimal Load, Scheduling-case study. Lighting- Energy efficient light sources, Energy conservation in Lighting Schemes, Electronic ballast-Power quality issues, Uminaries: casestudy.

MODULE-IV **(11 Hours)**

Cogeneration-types and Schemes, Optimal operation of cogeneration plants-case study, Electric loads of Air conditioning &Refrigeration, Energy conservation measures, Cool storage. Types-optimal operation case study, Electric water heating, Gysers, Solar Water Heaters, Power Consumption in Compressors, Energy conservation measures. Electrolytic Process. Computer Controls. Software- EMS.

Suggested reading

1. Giovanni Petrecca, "Industrial Energy Management: Principles and Applications", TheKluwer international series-207, 1999.
2. Anthony J. Pansini, Kenneth D. Smalling, "Guide to Electric Load Management", Pennwell Pub; (1998)
3. Handbook on Energy Audit and Environment Management, Y P Abbi and Shashank Jain, TERI, 2006
4. Handbook of Energy Audits Albert Thumann, William J. Younger, Terry Niehus, 2009.

Course Outcomes:

Students will be able to:

1. Acquire the background required for engineers to meet the role of energy managers and to acquire the skills and techniques required to implement energy management.
2. Identify and quantify the energy intensive business activities in an organization.
3. Knowledge about standard methodologies for measuring energy in the workplace and energy audit instruments.
4. Knowledge about energy efficient motors, load matching and selection of motors.
5. Acquire knowledge about reactive power management, capacitor sizing and degree of compensation.

PEC103	Power Electronics Laboratory	0-0-4	Credits 2

List of experiments:

1. 1 To study V-I characteristics of SCR and measure latching and holding currents.
2. To study UJT trigger circuit for half wave and full wave control.
3. To study single-phase half wave controlled rectified with (i) resistive load (ii) inductive load with and without free wheeling diode.
4. To study single phase (i) fully controlled (ii) half controlled bridge rectifiers with resistive and inductive loads.
5. To study three-phase fully/half controlled bridge rectifier with resistive and inductive loads.
6. To study single-phase ac voltage regulator with resistive and inductive loads.
7. To study single phase cyclo-converter.
8. To study triggering of (i) IGBT (ii) MOSFET (iii) power transistor.
9. To study operation of IGBT/MOSFET chopper circuit.
10. To study MOSFET/IGBT based single-phase series-resonant inverter.
11. To study MOSFET/IGBT based single-phase bridge inverter.

PEC104	Electrical Machines Laboratory	0-0-4	Credits 2

List of experiments:

1. Load test on dc shunt motor to draw speed – torque and horse power – efficiency characteristics.
2. Field Test on dc series machines.
3. Speed control of dc shunt motor by armature and field control.
4. Swinburne's Test on dc motor.
5. Retardation test on dc shunt motor.
6. Regenerative test on dc shunt machines.
7. Load test on three phase induction motor.
8. No load and Blocked rotor test on three phase induction motor to draw (i) equivalent circuit and (ii) circle diagram. Determination of performance parameters at different load conditions from (i) and (ii).
9. Load test on induction generator.
10. Load test on single phase induction motor to draw output versus torque, current, power and efficiency characteristics.
11. Conduct suitable tests to draw the equivalent circuit of single phase induction motor and determine performance parameters.
12. Conduct an experiment to draw V and inverted V curves of synchronous motor at no load and load conditions.

GHM101	Research Methodology & Intellectual Property Rights	2-0-0	Credits 2

MODULE-I **(06 Hours)**

Meaning of research problem, Sources of research problem, Criteria characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.

Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

MODULE-II **(04 Hours)**

Effective literature studies approaches, analysis,

Plagiarism, Research ethics.

MODULE-III **(04 Hours)**

Effective technical writing, how to write report, Paper.

Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

MODULE-IV **(06 Hours)**

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

MODULE-V **(04 Hours)**

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

MODULE-VI **(04 Hours)**

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Text/Reference Books:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science& engineering students'".
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"

4. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd, 2007.
5. Mayall, “Industrial Design”, McGraw Hill, 1992.
6. Niebel, “Product Design”, McGraw Hill, 1974.
7. Asimov, “Introduction to Design”, Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “Intellectual Property in New Technological Age”, 2016.
9. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008

Course Outcomes: At the end of the course, students will be able to

1. Understand research problem formulation.
2. Analyze research related information
3. Follow research ethics
4. Understand that today’s world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property.

   Right to be promoted among students in general & engineering in particular.
6. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Audit Courses

AHM101	English for Research Paper Writing	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Understand that how to improve your writing skills and level of readability
2. Learn about what to write in each section
3. Understand the skills needed when writing a Title

   Ensure the good quality of paper at very first-time submission

MODULE-I **(4 Hours)**

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

MODULE-II **(4 Hours)**

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction.

MODULE-III **(4 Hours)**

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

MODULE-IV **(4 Hours)**

key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed whenwriting a Review of the Literature.

MODULE-V **(4 Hours)**

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions.

MODULE-VI **(4 Hours)**

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

Suggested Studies:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book.

4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

ACE101	Disaster Management	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

MODULE-I **(4 Hours)**

Introduction

Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

MODULE-II **(4 Hours)**

Repercussions of Disasters and Hazards:

Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem.

Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

MODULE-III **(4 Hours)**

Disaster Prone Areas In India

Study of Seismic Zones; Areas Prone To Floods And Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics

MODULE-IV **(4 Hours)**

Disaster Preparedness and Management

Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data From Meteorological and Other Agencies, Media Reports: Governmental and

Community Preparedness.

MODULE-V **(4 Hours)**

Risk Assessment

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategiesfor Survival.

MODULE-VI **(4 Hours)**

Disaster Mitigation

Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation In India.

Text / Reference Books:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies, New Royal book Company.
2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences and Reflections", Prentice Hall OfIndia, New Delhi.
3. Goel S. L., Disaster Administration and Management Text and Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi.

AHM102	Sanskrit for Technical Knowledge	2-0-0	Credits 0

Course Objectives:

1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. Learning of Sanskrit to improve brain functioning
3. Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power
4. The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature

MODULE-I **(8 Hours)**

- Alphabets in Sanskrit
- Past/Present/Future Tense
- Simple Sentences

MODULE-II **(8 Hours)**

- Order
- Introduction of roots
- Technical information about Sanskrit Literature

MODULE-III **(8 Hours)**

- Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

Suggested reading:

1. "Abhyaspustakam" – Dr. Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

Course Output: Students will be able to

1. Understanding basic Sanskrit language
2. Ancient Sanskrit literature about science & technology can be understood
3. Being a logical language will help to develop logic in students

AHM103	Value Education	2-0-0	Credits 0

Course Objectives: Students will be able to

1. Understand value of education and self- development
2. Imbibe good values in students
3. Know about the importance of character

MODULE-I **(6 Hours)**

- Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism.
- Moral and non- moral valuation. Standards and principles.
- Value judgements

MODULE-II **(6 Hours)**

- Importance of cultivation of values.
- Sense of duty.Devotion, Self-reliance.Confidence, Concentration. Truthfulness, Cleanliness.
- Honesty, Humanity.Power of faith, National Unity.
- Patriotism.Love for nature, Discipline

MODULE-III **(6 Hours)**

- Personality and Behavior Development - Soul and Scientific attitude.
- Positive Thinking. Integrity and discipline.
- Punctuality, Love and Kindness.
- Avoid fault Thinking.
- Free from anger, Dignity of labour.
- Universal brotherhood and religious tolerance.
- True friendship.
- Happiness Vs suffering, love for truth.
- Aware of self-destructive habits.
- Association and Cooperation.
- Doing best for saving nature

MODULE-IV **(6 Hours)**

- Character and Competence –Holy books vs Blind faith.
- Self-management and Good health.
- Science of reincarnation.
- Equality, Nonviolence, Humility, Role of Women.
- All religions and same message.
- Mind your Mind, Self-control.
- Honesty, Studying effectively

Text / Reference Books

1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

Course outcomes: Students will be able to

1. Knowledge of self-development

2. Learn the importance of Human values
3. Developing the overall personality

AHM104	Constitution of India	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutionalrole and entitlement to civil and economic rights as well as the emergence of nationhood inthe early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the BolshevikRevolution in 1917 and its impact on the initial drafting of the Indian Constitution.

MODULE-I **(4 Hours)**

- **History of Making of the Indian Constitution:**

  History

  Drafting Committee, (Composition& Working)

MODULE-II **(4 Hours)**

- **Philosophy of the Indian Constitution:**

  Preamble

  Salient Features

MODULE-III **(4 Hours)**

- **Contours of Constitutional Rights & Duties:**

  Fundamental Rights

  Right to Equality

  Right to Freedom

  Right against Exploitation

  Right to Freedom of Religion

  Cultural and Educational Rights

  Right to Constitutional Remedies

  Directive Principles of State Policy

Fundamental Duties.

MODULE-IV **(4 Hours)**

- **Organs of Governance:**

  Parliament

  Composition

  Qualifications and Disqualifications

  Powers and Functions

  Executive

  President

  Governor

  Council of Ministers

  Judiciary, Appointment and Transfer of Judges, Qualifications

  Powers and Functions

MODULE-V **(4 Hours)**

- **Local Administration:**

  District's Administration head: Role and Importance,

  Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation.

  Pachayati raj: Introduction, PRI: ZilaPachayat.

  Elected officials and their roles, CEO ZilaPachayat: Position and role.

  Block level: Organizational Hierarchy (Different departments),

  Village level: Role of Elected and Appointed officials,

  Importance of grass root democracy

  Model Curriculum of Engineering & Technology PG Courses [Volume -II]

MODULE-VI **(4 Hours)**

- **Election Commission:**

  Election Commission: Role and Functioning.

  Chief Election Commissioner and Election Commissioners.

  State Election Commission: Role and Functioning.

  Institute and Bodies for the welfare of SC/ST/OBC and women.

Text / Reference Books:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Outcomes: Students will be able to:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the passage of the Hindu Code Bill of 1956.

AHM105	Pedagogy Studies	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Review existing evidence on the review topic to inform programme design and policymaking undertaken by the DfID, other agencies and researchers.
2. Identify critical evidence gaps to guide the development.

MODULE-I **(4 Hours)**

- **Introduction and Methodology:**
- Aims and rationale, Policy background, Conceptual framework and terminology
- Theories of learning, Curriculum, Teacher education.
- Conceptual framework, Research questions**.**
- Overview of methodology and Searching.

MODULE-II **(2 Hours)**

- Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries.
- Curriculum, Teacher education.

MODULE-III **(4 Hours)**

- Evidence on the effectiveness of pedagogical practices
- Methodology for the in depth stage: quality assessment of included studies.
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?
- Theory of change.
- Strength and nature of the body of evidence for effective pedagogical practices.
- Pedagogic theory and pedagogical approaches.
- Teachers' attitudes and beliefs and Pedagogic strategies.

MODULE-IV **(4 Hours)**

- Professional development: alignment with classroom practices and follow up support
- Peer support
- Support from the head teacher and the community.
- Curriculum and assessment
- Barriers to learning: limited resources and large class sizes

MODULE-V **(2 Hours)**

- **Research gaps and future directions**
- Research design
- Contexts
- Pedagogy
- Teacher education
- Curriculum and assessment
- Dissemination and research impact.

Text / Reference Books:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2):245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal ofCurriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International JournalEducational

Development, 33 (3): 272–282.

5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

Course outcomes: Students will be able to understand:

1. What pedagogical practices are being used by teachers in formal and informal classrooms indeveloping countries?
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, andwith what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

AHM106	Stress Management by Yoga	2-0-0	Credits 0

Course Objectives:

1. To achieve overall health of body and mind
2. To overcome stress

MODULE-I **(8 Hours)**

- Definitions of Eight parts of yoga. (Ashtanga)

MODULE-II **(8 Hours)**

- Yam and Niyam.

  Do`s and Don't's in life.

  i) Ahinsa, satya, astheya, bramhacharya and aparigraha

  ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

MODULE-III **(8 Hours)**

- Asan and Pranayam

  i) Various yog poses and their benefits for mind & body

  ii) Regularization of breathing techniques and its effects-Types of pranayam

Text / Reference Books:

1. 'Yogic Asanas for Group Tarining-Part-I": Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

Course outcomes: Students will be able to:

1. Develop healthy mind in a healthy body thus improving social health also
2. Improve efficiency

AHM107	Personality Development through Life Enlightenment Skills	2-0-0	Credits 0

Course Objectives:

1. To learn to achieve the highest goal happily
2. To become a person with stable mind, pleasing personality and determination
3. To awaken wisdom in students

MODULE-I **(8 Hours)**

Neetisatakam-Holistic development of personality

- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)
- Verses- 52,53,59 (dont's)
- Verses- 71,73,75,78 (do's)

MODULE-II **(8 Hours)**

Approach to day to day work and duties.

- Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48,
- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,
- Chapter 18-Verses 45, 46, 48.

MODULE-III **(8 Hours)**

Statements of basic knowledge.

- Shrimad Bhagwad Geeta: Chapter 2- Verses 56, 62, 68

- Chapter 12 - Verses 13, 14, 15, 16,17, 18
- Personality of Role model. Shrimad Bhagwad Geeta: Chapter 2- Verses 17, Chapter 3-Verses 36,37,42,
- Chapter 4-Verses 18, 38,39
- Chapter18 – Verses 37,38,63

Text / Reference Books:

1. "Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P. Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

Course outcomes: Students will be able to:

1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity
3. Study of Neetishatakam will help in developing versatile personality of students.

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

M.TECH SYLLABUS for *Specialization*: POWER ELECTRONICS AND DRIVES

BRANCH: ELECTRICAL ENGINEERING (2018-19 Admission Batch)

2nd Semester

PEC201	Electric Drives System	3-0-0	Credits 3

Course Objectives:

Students will be able to:

1. Understand Basic electrical drives and their analysis.
2. Learn Design of controller for drives.
3. Understand Scalar control of electrical drives.

Syllabus

MODULE-I **(10 Hours)**

Dynamics of Electric Drives: Fundamentals of torque equation, Speed torque convention and Multi-quadrant operation, components of load torques. Classification of load torques steady state stability, Load equation, Speed control and drive classification, close loop control of drives.

MODULE-II **(10 Hours)**

DC motor Drives: Modeling of DC machines, Steady state characteristics with armature and speed control, Phase controlled DC motor drives, chopper controlled DC motor drives.

MODULE-III **(12 Hours)**

Poly-phase induction machines: Dynamic modeling of induction machines, Small signal equations, control characteristics of induction machines, Phase-controlled induction machines, Stator voltage control, Slip energy recovery scheme, frequency control and vector control of induction motor drives.

MODULE-IV **(10 Hours)**

Traction motor: starting, speed-time characteristics, braking, Traction motors used in practice. Industrial Drives: Digital Control of Electric Drives, Stepper motor, Servo motor and their Applications.

Suggested reading

1. G.K, Dubey, "Power semiconductor controlled Drives", Prentice Hall international, New Jersey, 1989.
2. R. Krishanam, “Electric motor drives modeling, analysis and control”, PHI-India-2009.
3. G. K. Dubey, “Fundamentals of electric Drives, Narosa Publishing House”, 2nd edition, 2011.
4. W. Leonhard, “Control of Electrical drives”, Springer, 3rd edition, 2001.
5. P.C. Krause –, “Analysis of Electric Machine”, Wiley-IEEE press3rdedition.
6. K. Bose, “Modern Power Electronics and AC Drives”, Prentice Hall publication, 1st edition,

2001.

Course Outcomes:

Students will be able to:

1. Model and simulate electric drive systems
2. Design modulation strategies of power electronics converters, for drives application
3. Design appropriate current/voltage regulators for electric drives
4. Select and implement the drives for Industrial Process Implement various variable speed drives in Electrical Energy Conversion System

PEC202	Digital Control of Power Electronic and Drive Systems	3-0-0	Credits 3

Course Objectives:

Students will be able to:

1. To understand different control strategies
2. To understand state space modeling of different converters
3. To perform simulation of different power converters

MODULE-I **(12 Hours)**

Review of numerical methods, Application of numerical methods to solve transients in D.C., Switched R, L, R-L, R-C and R-L-C circuits. Extension to AC circuits, Modelling of diode in simulation, Diode with R, R-L, R-C and R-L-C load with AC supply, Modelling of SCR, TRIAC, IGBT and Power Transistors in simulation, Application of numerical methods to R, L, C circuits with power electronic switches, Simulation of gate/base drive circuits, simulation of snubber circuits.

MODULE-II **(8 Hours)**

State space modeling and simulation of linear systems. Introduction to electrical machine modeling: induction, D.C and synchronous machines, simulation of basic electric drives, stability aspects.

MODULE-III **(11 Hours)**

Simulation of single phase and three phase uncontrolled and controlled (SCR)rectifiers, Converters with self-commutated devices- simulation of power factor correction schemes, Simulation of converter fed DC motor drives, Simulation of thyristor choppers with voltage, Current and load commutation schemes, Simulation of chopper fed DC motor.

MODULE-IV **(11 Hours)**

Simulation of single and three phase inverters with thyristors and self- commutated devices, Space vector representation, Pulse-width modulation methods for voltage control, Waveform control. Simulation of inverter fed induction motor drives.

Suggested reading

1. Simulink Reference Manual, Math works, USA

Course Outcomes:

Students will be able to:

1. To provide knowledge on modelling and simulation of power simulation circuits and systems.
2. The candidate will be able to simulate power electronic systems and analyze the system response.

PEE201	Switched Mode and Resonant Converters	3-0-0	Credits 3

Course Objectives:

Students will be able to:

1. To understand different types of converters
2. To understand different switch mode topologies & control methods
3. To understand different resonant converter topologies.

MODULE-I **(12 Hours)**

Buck, Boost, Buck-Boost SMPS Topologies, Basic Operation-Waveforms - modes of operation –switching stresses, Switching and conduction losses. Optimum switching frequency, Practical voltage, current and power limits – design relations, Voltage mode control principles, Push-Pull and Forward Converter Topologies – Basic Operation, Waveforms, Flux Imbalance Problem and Solutions, Transformer Design. Output Filter Design. Switching Stresses and Losses, Forward Converter Magnetics. Voltage Mode Control, Half and Full Bridge Converters. Basic Operation and Waveforms, Magnetics, Output Filter, Flux Imbalance, Switching Stresses and Losses, Power Limits, Voltage Mode Control.

MODULE-II **(10 Hours)**

Classification of Resonant Converters. Basic Resonant Circuit Concepts, Load Resonant Converter, Resonant Switch Converter, Zero Voltage Switching Clamped Voltage Topologies, Resonant DC Link Inverters with Zero Voltage Switching, High Frequency Link Integral Half Cycle Converter, Fly back Converter-discontinuous mode operation, waveforms, control, Magnetics- Switching Stresses and Losses, Disadvantages - Continuous Mode Operation, waveforms, control, design relations.

MODULE-III **(10 Hours)**

Voltage Mode Control of SMPS- Loop Gain and Stability Considerations, Error Amp– frequency Response and Transfer Function, Trans-conductance Current Mode Control of SMPS, Current Mode Control Advantages, Current Mode Vs Voltage Mode, Current Mode Deficiencies, Slope Compensation, Study of a typical Current Mode PWM Control IC UC3842. Modeling of SMPS, Small Signal Approximation- General Second Order Linear Equivalent Circuits, Study of popular PWM Control ICs (SG 3525, TL494, MC34060 etc.).

MODULE-IV **(10 Hours)**

DC Transformer, Voltage Mode SMPS Transfer Function, General Control Law Consideration, EMI Generation and Filtering in SMPS - Conducted and Radiated Emission Mechanisms in SMPS, Techniques to reduce Emissions, Control of Switching Loci, Shielding and Grounding, Power Circuit Layout for minimum EMI, EMI Filtering at Input and Output, Effect of EMI Filter on SMPS Control Dynamics, Introduction to Resonant Converters.

Suggested reading

1. Abraham I Pressman, "Switching Power Supply Design", McGraw Hill Publishing Company, 2001.
2. Daniel M Mitchell, "DC-DC Switching Regulator Analysis", McGraw Hill Publishing Company-1988.
3. Ned Mohan et.al, "Power Electronics," John Wiley and Sons2006.

Course Outcomes:

1. Acquire knowledge about the principles of operation of non-isolated and isolated hard-switched DC-DC converters.
2. Acquire knowledge on various loss components in a switched mode converter and choice of switching frequency with a view towards design of such converters.

PEE202	Advanced Power Electronic Circuits	3-0-0	Credits 3

Course Objectives:

Students will be able to:

1. Understand the operation of advanced power electronic circuit topologies.
2. Understand the control strategies involved.
3. Learn few practical circuits, used in practice.

MODULE-I **(10 Hours)**

Boost type APFC and control, three phase utility inter phases and control-Buck, Boost, Buck-Boost SMPS

Topologies.

MODULE-II **(10 Hours)**

Modes of operation –Push-Pull and Forward Converter Topologies – Voltage Mode Control, Half and Full Bridge Converters.

MODULE-III **(10 Hours)**

Fly back Converter, Introduction to Resonant Converters, Load Resonant Converter. Zero Voltage Switching Clamped Voltage Topologies.

MODULE-IV **(12 Hours)**

Resonant DC Link Inverters with Zero Voltage Switching, High Frequency Link Integral Half Cycle Converter, Modeling and design of DC-DC Converters for various renewable energy conversion. Few power electronic circuits used in practice for controlling electric drives.

Suggested reading

1. Rashid "Power Electronics" Prentice Hall India 2007.
2. G.K. Dubey et.al "Thyristorised Power Controllers" Wiley Eastern Ltd., 2005, 06.
3. Dewan&Straughen "Power Semiconductor Circuits" John Wiley &Sons.,1975.
4. G.K. Dubey& C.R. Kasaravada "Power Electronics & Drives" Tata McGraw Hill., 1993
5. Cyril W Lander "Power Electronics" McGraw Hill., 2005.
6. B. K Bose "Modern Power Electronics and AC Drives" Pearson Education (Asia)., 2007
7. Abraham I Pressman "Switching Power Supply Design" McGraw Hill Publishing Company, 2001.

Course Outcomes:

Students will be able to:

1. Knowledge about analysis and design of Load Commutated CSI and PWM CSI.
2. Learn analysis and design of series Inverters.
3. Acquire knowledge about analysis and design of Switched Mode Rectifiers, APFC, DC-DC converters &Resonant converters

PEE203	Advanced Digital Signal Processing	3-0-0	Credits 3

Course Objectives:

Students will be able to:

1. To understand the difference between discrete-time and continuous-time signals
2. To understand and apply Discrete Fourier Transforms (DFT)

MODULE-I **(12 Hours)**

Discrete time signals, Linear shift invariant systems-Stability and causality, Sampling of continuous time signals-Discrete time Fourier transform- Discrete Fourier series- Discrete Fourier transform, Z transform-Properties of different transforms, Linear convolution using DFT, Computation of DFT Design of IIR digital filters from analog filters, Impulse invariance method, Bilinear transformation method.

MODULE-II **(10 Hours)**

FIR filter design using window functions, Comparison of IIR and FIR digital filters, Basic IIR and FIR filter realization structures, Signal flow graph representations Quantization process and errors, Coefficient quantization effects in IIR and FIR filters.

MODULE-III **(12 Hours)**

A/D conversion noise- Arithmetic round-off errors, Dynamic range scaling, Overflow oscillations and zero-Input limit cycles in IIR filters, Linear Signal Models, All pole, All zero and Pole-zero models, Power spectrum estimation- Spectral analysis of deterministic signals, Estimation of power spectrum of stationary random signals.

MODULE-IV **(8 Hours)**

Optimum linear filters, Optimum signal estimation, Mean square error estimation, Optimum FIR and IIR Filters.

Suggested reading

1. Sanjit K Mitra, "Digital Signal Processing: A computer-based approach ", Tata McGraw-Hill Edition 1998
2. Dimitris G. Manolakis, VinayK. Ingle and Stephen M. Kogon, "Statistical and Adaptive Signal Processing", McGraw Hill international editions. -2000

Course Outcomes:

Students will be able to:

1. Knowledge about the time domain and frequency domain representations as well
2. Analysisofdiscrete time signals and systems.
3. Study the design techniques for IIR and FIR filters and their realization structures.

4. Acquire knowledge about the finite word length effects in implementation of digital filters.
5. Knowledge about the various linear signal models and estimation of power spectrum of stationary random signals
6. Design of optimum FIR and IIR filters

PEE204	Advanced Microcontroller based Systems	3-0-0	Credits 3

Course Objectives:

Students will be able to:

1. To understand the architecture of advance microcontrollers
2. To understand the applications of these controllers
3. To get some introduction to FPGA.

MODULE-I **(10 Hours)**

Basic Computer Organization, Accumulator based processes-Architecture-Memory, Organization-I/O Organization.

MODULE-II **(10 Hours)**

Micro-Controllers-Intel 8051, Intel 8056- Registers, Memories, I/O Ports, Serial Communication. Timers, Interrupts, Programming. Intel 8051 – Assembly language programming-Addressing-Operations- Stack &Subroutines, Interrupts-DMA.

MODULE-III **(10 Hours)**

PIC 16F877- Architecture Programming, Interfacing Memory/ I/O Devices, Serial I/O and data communication.

MODULE-IV **(12 Hours)**

Digital signal processor (DSP)- Architecture- Programming, Introduction to FPGA, Microcontroller development for motor control applications, Stepper motor control using microcontroller.

Suggested reading

1. John.F.Wakerly: "Microcomputer Architecture and Programming", John Wiley and Sons1981.
2. Ramesh S.Gaonker: "Microprocessor Architecture, Programming and Applications with the 8085", Penram International Publishing (India), 1994.
3. Raj Kamal: "The Concepts and Features of Microcontrollers", Wheeler Publishing, 2005.
4. Kenneth J. Ayala, "The 8051 microcontroller", Cengage Learning, 2004.
5. John Morton," The PIC microcontroller: your personal introductory course", Elsevier, 2005.

6. Dogan Ibrahim," Advanced PIC microcontroller projects in C: from USB to RTOS with the PIC18F Series", Elsevier, 2008.
7. Microchip datasheets forPIC16F877.

Course Outcomes:

Students will be able to:

1. To learn how to program a processor in assembly language and develop an advanced processor based system.
2. To learn configuring and using different peripherals in a digital system.
3. To compile and debug a Program.
4. To generate an executable file and use it.

PEE205	Distributed Generation	3-0-0	Credits 3

Course Objectives:

Students will be able to

1. Understand renewable energy sources.
2. Gain understanding of the working of off-grid and grid-connected renewable energy generation schemes.

MODULE-I **(12 Hours)**

Need for Distributed generation, Renewable sources in distributed generation,

Current scenario in Distributed Generation, Planning of DGs, Sitting and sizing of DGs optimal placement of DG sources in distribution systems, Grid integration of DGs Different types of interfaces, Inverter based DGs and rotating machine based interfaces, Aggregation of multiple DG units.

MODULE-II **(10 Hours)**

Technical impacts of DGs. Transmission systems Distribution systems De-regulation Impact of DGs upon protective relaying. Impact of DGsupon transient and dynamic stability of existing. Distribution systems, Steady-state and Dynamic analysis**.**

MODULE-III **(8 Hours)**

Economic and control aspects of DGs Market facts. Issues and challenges Limitations of DGs. Voltage control techniques. Reactive power control. Harmonics Power quality issues.

Reliability of DG based systems.

MODULE-IV **(12 Hours)**

Introduction to micro-grids. Types of micro-grids: autonomous and non-autonomous grids Sizing of micro-grids. Modelling& analysis of Micro-grids with multiple DGs. Micro-grids with power electronic interfacing units. Transients in micro-grids. Protection of micro-grids. Case studies. Advanced topics.

Suggested reading

1. H. Lee Willis, Walter G. Scott, "Distributed Power Generation – Planning and Evaluation", Marcel Decker Press.
2. M.GodoySimoes, Felix A. Farret, "Renewable Energy Systems – Design and Analysis with Induction Generators", CRCpress.
3. Stuart Borlase." Smart Grid: Infrastructure Technology Solutions" CRC Press

Course outcomes:

Students will be able to

1. Understand the planning and operational issues related to Distributed Generation.
2. Acquire Knowledge about Distributed Generation
3. Learn Micro-Grids

PEE206	Smart Grids	3-0-0	Credits 3

Course Objectives:

Students will be able to:

1. Understand concept of smart grid and its advantages over conventional grid.
2. Know smart metering techniques.
3. Learn wide area measurement techniques.
4. Understanding the problems associated with integration of distributed generation & its solution through smart grid.

MODULE-I **(12 Hours)**

Introduction to Smart Grid. Evolution of Electric Grid. Concept of Smart Grid, Definitions. Need of Smart Grid. Concept of Robust &Self Healing Grid. Present development & International policies in Smart Grid. Introduction to Smart Meters. Real Time Prizing. Smart Appliances. Automatic Meter Reading (AMR).Outage Management System (OMS).Plug in Hybrid Electric Vehicles (PHEV).Vehicle to Grid. Smart Sensors. Home& Building Automation. Smart Substations. Substation Automation. Feeder Automation

MODULE-II **(8 Hours)**

Geographic Information System (GIS). Intelligent Electronic Devices(IED) & their application for monitoring & protection. Smart storage like Battery. SMES. Pumped Hydro. Compressed Air Energy Storage. Wide Area

Measurement System (WAMS). Phase Measurement Unit (PMU)

MODULE-III **(10 Hours)**

Concept of micro-grid. Need & applications of micro-grid. Formation of micro-grid. Issues of Interconnection. Protection & control of micro-grid. Plastic & Organic solar cells. Thin film solar cells. Variable speed wind generators. Fuel-cells. Micro-turbines. Captive power plants. Integration of renewable energy sources.

MODULE-IV **(12 Hours)**

Power Quality & EMC in Smart Grid. Power Quality issues of Grid connected Renewable Energy Sources. Power Quality Conditioners for Smart Grid. Web based Power Quality monitoring. Power Quality Audit Advanced Metering Infrastructure (AMI). Home Area Network (HAN), Neighborhood Area Network (NAN). Wide Area Network (WAN). Bluetooth. Zig Bee. GPS, Wi-Fi. Wi-Max based communication. Wireless Mesh Network. Basics of CLOUD Computing & Cyber Security for Smart Grid. Broadband over Powerline (BPL). IP based protocols

Suggested reading

1. Ali Keyhani, "Design of smart power grid renewable energy systems", Wiley IEEE, 2011.
2. Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response", CRC Press, 2009.
3. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, "Smart Grid: Technology and Applications", Wiley 2012.
4. Stuart Borlase, "Smart Grid Infrastructure, Technology and solutions" CRC Press.
5. A.G. Phadke, "Synchronized Phasor Measurement and their Applications", Springer.

Course Outcomes

Students will be able to

1. Appreciate the difference between smart grid & conventional grid
2. Apply smart metering concepts to industrial and commercial installations
3. Formulate solutions in the areas of smart substations, distributed generation and wide area measurements
4. Come up with smart grid solutions using modern communication technologies

PEC203	Electrical Drives Laboratory	0-0-4	Credits 2

List of experiments:

1. Study of Thyristor controlled D.C Drive.
2. Study of Chopper Fed DC Motor.
3. Study of A.C single phase motor speed control using TRIAC.
4. PWM inverter fed three phase induction motor control using PSPICE/MATLAB/PSIM software.
5. VSI/CSI fed induction motor drive analysis using MATLAB/PSPICE/PSIM software.
6. Study of V/f control operation of three phase induction motor.
7. Study of permanent magnet synchronous motor drive fed by PWM inverter using software.
8. Regenerative/ Dynamic breaking operation for DC motor study using software.
9. Regenerative/ Dynamic breaking operation for AC motor study using software.
10. PC/PLC based AC/DC motor control operation.

PEC204	Digital Signal Processing Lab	0-0-4	Credits 2

1. Introduction to Composer Studio-I
2. Introduction to Code Composer Studio-II
3. Introduction to the Addressing Modes.
4. FFT and Bit Reversal Operation.
5. FFT and its Applications.
6. Audio Codec and its Applications.
7. Real Time Data Exchange.
8. IR filtering by interfacing MATLAB with Code Composer Studio.
9. Introduction to Interrupts.
10. Digital communication using Binary Phase Shift Keying.

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

M.TECH SYLLABUS for *Specialization*: POWER ELECTRONICS AND DRIVES

BRANCH: ELECTRICAL ENGINEERING (2018-19 Admission Batch)

3rd Semester

PEE301	SCADA Systems and Applications	3-0-0	Credits 3

Course Objectives:

Students will be able to:

1. To understand what is meant by SCADA and its functions.
2. To know SCADA communication.
3. To get an insight into its application.

MODULE-I **(11 Hours)**

Introduction to SCADA: Data acquisition systems, Evolution of SCADA, Communication technologies. Monitoring and supervisory functions, SCADA applications in Utility Automation, Industries SCADA.

MODULE-II **(11 Hours)**

Industries SCADA System Components: Schemes- Remote Terminal Unit (RTU), Intelligent Electronic Devices (IED), Programmable Logic Controller (PLC), Communication Network, SCADA Server, SCADA/HMI Systems.

MODULE-III **(10 Hours)**

SCADA Architecture: Various SCADA architectures, advantages and disadvantages of each system - single unified standard architecture -IEC 61850, SCADA Communication: various industrial communication technologies wired and wireless methods and fiber optics. Open standard communication protocols.

MODULE-IV **(10 Hours)**

SCADA Applications: Utility applications-Transmission and Distribution sector- operations, monitoring, analysis and improvement. Industries - oil, as and water. Case studies, Implementation, Simulation Exercises

Suggested reading

1. Stuart A. Boyer: "SCADA-Supervisory Control and Data Acquisition", Instrument Society of America Publications, USA, 2004.
2. Gordon Clarke, Deon Reynders: "Practical Modern SCADA Protocols: DNP3, 60870.5 and RelatedSystems", Newnes Publications, Oxford, UK, 2004.
3. William T. Shaw, "Cybersecurity for SCADA systems", PennWell Books, 2006.
4. David Bailey, Edwin Wright, "Practical SCADA for industry", Newnes, 2003.
5. Wiebe, "A guide to utility automation: AMR, SCADA, and IT systems for electric power", PennWell 1999.

Course Outcomes:

1. Describe the basic tasks of Supervisory Control Systems (SCADA) as well as their typical applications**.**
2. Acquire knowledge about SCADA architecture, various advantages and disadvantages of each system.
3. Knowledge about single unified standard architecture IEC61850.
4. To learn about SCADA system components: remote terminal units, PLCs, intelligent electronic devices, HMI systems, SCADA server.
5. Learn and understand about SCADA applications in transmission and distribution sector, industries etc.

PEE302	FACTS and Custom Power Devices	3-0-0	Credits 3

Course Objectives:

Students will be able to:

1. To learn the active and reactive power flow control in power system
2. To understand the need for static compensators
3. To develop the different control strategies used for compensation

MODULE-I **(11 Hours)**

Reactive power flow control in Power Systems – Control of dynamic power unbalances in Power System, Power flow control -Constraints of maximum transmission line loading – Benefits of FACTS Transmission line compensation.

Uncompensated line -Shunt compensation - Series compensation–Phase angle control. Reactive power compensation. Shunt and Series compensation principles – Reactive compensation transmission and distribution level.

MODULE-II **(10 Hours)**

Static versus passive VAR compensator, Static shunt compensators: SVC and STATCOM - Operation and control of TSC, TCR and STATCOM – Compensator control.

Comparison between SVC and STATCOM. Static series compensation: TSSC, SSSC -Static voltage and phase angle regulators – TCVR and TCPAR Operation and Control –Applications, Static series compensation–GCSC, TSSC, TCSC and Static synchronous series compensators and their Control.

MODULE-III **(11 Hours)**

SSR and its damping Unified Power Flow Controller: Circuit Arrangement, Operation and control of UPF.

Basic Principle of P and Q control- Independent real and reactive power flow control-Applications.

MODULE-IV **(10 Hours)**

Introduction to interline power flow controller. Modeling and analysis of FACTS Controllers – Simulation of FACTS controllers Power quality problems in distribution systems, harmonics. Loads that create harmonics, modeling, harmonic propagation, series and parallel resonances, mitigation of harmonics, passive filters, active filtering– shunt, series and hybrid and their control. Voltage swells, sags, flicker, unbalance and mitigation of these problems by power line conditioners- IEEE standards on power quality.

Suggested reading

1. K R Padiyar, "FACTS Controllers in Power Transmission and Distribution", New Age International Publishers, 2007**.**
2. X P Zhang, C Rehtanz, B Pal, "Flexible AC Transmission Systems- Modelling and Control", SpringerVerlag, Berlin, 2006.
3. N.G. Hingorani, L. Gyugyi, "Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems", IEEE Press Book, Standard Publishers and Distributors, Delhi, 2001.
4. K.S. Suresh kumar, S. Ashok, "FACTS Controllers & Applications", E-book edition, NalandaDigital Library, NIT Calicut, 2003.
5. G. T. Heydt, "Power Quality", McGraw-Hill Professional, 2007.
6. T. J. E. Miller, "Static Reactive Power Compensation", John Wiley and Sons, Newyork,1982.

Course Outcomes:

Students will be able to:

1. Acquire knowledge about the fundamental principles of Passive and Active Reactive Power Compensation Schemes at Transmission and Distribution level in Power Systems.
2. Learn various Static VAR Compensation Schemes like Thyristor /GTO Controlled.
3. Reactive Power Systems, PWM Inverter based Reactive Power Systems and their controls.
4. To develop analytical modeling skills needed for modeling and analysis of such Static VAR Systems.

PEE303	High Voltage DC Transmission	3-0-0	Credits 3

Course Objectives:

Students will be able to:

1. Understand state of the art HVDC technology.
2. Learn the Methods to carry out modeling and analysis of HVDC system frontier-area power flow regulation.

Syllabus

MODULE-I **(11 Hours)**

Development of HVDC Technology, DC versus AC Transmission, Selection of converter configuration. Rectifier and Inverter operation, Digital Simulation of converters, Control of HVDC converters and Systems.

MODULE-II **(10 Hours)**

Individual phase control, Equidistant firing controls, Higher level controls. Characteristics and non-characteristics harmonics filter design. Fault development and protection.

MODULE-III **(11 Hours)**

Interaction between AC-DC power systems. Over voltages on AC/DC side, multi-terminal HVDC systems, control of MTDC systems, Modelling of HVDC systems, per unit system, Representation for power flow solution, representation for stability studies.

MODULE-IV **(10 Hours)**

Introduction to relevant national and international standards, safe clearances for HV, Study regulations for HV tests, Digital techniques in HV measurements.

Suggested reading

1. J. Arrillaga, "High Voltage Direct Transmission", Peter Peregrinus Ltd. London, 1983.
2. K. R. Padiyar, "HVDC Power Transmission Systems", Wiley Eastern Ltd., 1990.
3. E. W. Kimbark, "Direct Current Transmission", Vol. I, Wiley Interscience, 1971.
4. Erich Uhlmann, "Power Transmission by Direct Current", B.S. Publications, 2004.

Course Outcomes:

Students will be able to:

1. To expose the students to the state of the art HVDC technology.
2. Knowledge of modelling and analysis of HVDC system for inter-area power flow regulation.

PEE304	Advanced Electric Drives	3-0-0	Credits 3

Course Objectives:

Students will be able to:

1. Understand advanced electrical drives and their analysis.
2. Learn Design of controller for drives.
3. Understand Scalar and Vector control of electrical drives.

MODULE-I **(10 Hours)**

Principles for vector and field-oriented control-Complex-valued dq-model of induction machines. Turns ratio and modified dq-models. Principles for field-oriented vector control of ac machines. Current controllers in stationary and synchronous coordinates. Rotor-flux oriented control of current-regulated induction machine.

MODULE-II **(10 Hours)**

Dynamic model of IM in rotor-flux coordinates. Indirect rotor-flux oriented control of IM - Direct rotor-flux oriented control of IM. - Methods to estimation of rotor-flux Generalized flux-vector control using current- and voltage decoupling networks. Generalized flux-vector oriented control. Current and voltage decoupling networks. Airgap-oriented control. Voltage-fed vector control. Stator-flux oriented vector control.

MODULE-III **(11 Hours)**

Parameter sensitivity, selection of flux level, and field weakening - Parameterdetuning in steady-state operation. Parameter detuning during dynamics. Selection of flux level. Control strategies for used in the over-speed region.

MODULE-IV **(11 Hours)**

Principles for speed sensor-less control - Principles for speed sensor-lesscontrol. Sensor-less methods for scalar control. Sensor-less methods for vector control. Introduction to observer-based techniques. Direct torque control Induction Motor Drives. Self control synchronous motor drives. Introduction to speed control of switched reluctance machine. Control of Permanent magnet synchronous machine, Brushless dc Machine, Surface Permanent Magnet Machine and interior.

Text/References:

1. B. K. Bose, Modern Power Electronics and A.C. Drives, PHI, 2002.
2. G. K. Dubey, Power Semiconductor Controlled Drives, Prentice-Hall International1989.

Supplementary Reading:

1. G. K. Dubey, Fundamentals of Electrical Drives, Narosa Publishing House, 2002.
2. W. Leonhard, Control of Electrical drives, Springer-Verlag, 1985.
3. P.C. Sen, Thyristor DC Drives, Wiley-Interscience Pub., Digitized on Dec, 2006.

Course Outcomes: Students will be able to:

1. Model and simulate electric drive systems
2. Design modulation strategies of power electronics converters, for drives application
3. Design appropriate current/voltage regulators for electric drives
4. Select and implement the drives for Industrial Process
5. Implement various variable speed drives in Electrical Energy Conversion System

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BRANCH: ELECTRICAL ENGINEERING (2018-19 Admission Batch)

First Semester				Second Semester			
Theory				**Theory**			
Course Code	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**	**Course Code**	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**
	Programme Core-1	3-0-0	3		**Programme Core-3**	3-0-0	3
PSC101	Power System Analysis			PSC201	Digital Protection of Power System		
	Programme Core-2	3-0-0	3		**Programme Core-4**	3-0-0	3
PSC102	Power System Dynamics-I			PSC202	Power System Dynamics-II		
	Programme Elective-1 (Any One)	3-0-0	3		**Programme Elective-3 (Any One)**	3-0-0	3
PSE101	Renewable Energy System			PSE201	Restructured Power Systems		
PSE102	Smart Grids			PSE202	Advanced Digital Signal Processing		
PSE103	High Power Converters			PSE203	Power Apparatus Design	3-0-0	3
	Programme Elective-2 (Any One)	3-0-0	3		**Programme Elective-4 (Any One)**		
PSE104	Electrical Power Distribution System			PSE204	SCADA System and Applications		
PSE105	Pulse Width Modulation for PE Converters			PSE205	Power Quality		
PSE106	Electric and Hybrid Vehicles			PSE206	Artifical Intelligence Techniques	2-0-0	0
GHM101	Research Methodology & Intellectual Property Rights	2-0-0	2		**Audit Course-2 (Any One from the list of Audit Courses)**		
	Audit Course-1 (Any One from the list of Audit Courses)	2-0-0	0				
	Total (Theory)	**16**	**14**		**Total (Theory)**	**14**	**12**
	Practical/ Sessional				**Practical/ Sessional**		
	Lab-1	0-0-4	2		**Lab-3**	0-0-4	2
PSC103	Power System Lab			PSC203	Power System Lab-II		
	Lab-2	0-0-4	2		**Lab-4**	0-0-4	2
PSC104	Renewable Energy Lab			PSC204	Power Electronics and Applications Lab		
				PSJ201	**Mini Project with Seminar**	0-0-4	2
Total (Practical/ Sessional)		**8**	**4**	**Total (Practical/ Sessional)**		**12**	**6**
TOTAL		**24**	**18**	**TOTAL**		**26**	**18**
TOTAL SEMESTER CREDITS: 18				TOTAL SEMESTER CREDITS: 18			
TOTAL CUMULATIVE CREDITS: 18				TOTAL CUMULATIVE CREDITS: 36			

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Third Semester				Fourth Semester			
Theory				**Theory**			
Course Code	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**	**Course Code**	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**
	Programme Elective-5 (Any One)	3-0-0	3				
PSE301	Power System Transients						
PSE302	FACTS and Custom Power Devices						
PSE303	Industrial Load Modelling and Control						
	Open Elective (Any One)	3-0-0	3				
	Business Analytics						
	Industrial Safety						
	Operations Research						
	Cost Management of Engineering Projects						
	Composite Materials						
	Waste to Energy						
	Internet of Things						
	Soft Computing						
	Project Engineering & Management						
	Start-up & Entrepreneurship Development						
	Total (Theory)	**6**	**6**		**Total (Theory)**	**0**	**0**
	Practical/ Sessional				**Practical/ Sessional**		
PSJ301	Dissertation Phase-I	0-0-20	10	PSJ401	Dissertation Phase-II	0-0-32	16
	Total (Practical/ Sessional)	**20**	**10**		**Total (Practical/ Sessional)**	**32**	**16**
	TOTAL	**26**	**16**		**TOTAL**	**32**	**16**
TOTAL SEMESTER CREDITS: 16				TOTAL SEMESTER CREDITS: 16			
TOTAL CUMULATIVE CREDITS: 52				TOTAL CUMULATIVE CREDITS: 68			

List of Audit courses

1. AHM101 English for Research Paper Writing
2. ACE101 Disaster Management
3. AHM102 Sanskrit for Technical Knowledge
4. AHM103 Value Education
5. AHM104 Constitution of India
6. AHM105 Pedagogy Studies
7. AHM106 Stress Management by Yoga
8. AHM107 Personality Development through Life Enlightenment Skills

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M.TECH SYLLABUS for *Specialization*: POWER SYSTEM ENGINEERING

BRANCH: ELECTRICAL ENGINEERING (2018-19 Admission Batch)

1st Semester

PSC101	Power System Analysis	3-0-0	Credits 3

Course Objectives-

Students will be able to:

1. Study various methods of load flow and their advantages anddisadvantages
2. Understand how to analyze various types of faults in powersystem
3. Understand power system security concepts and study the methods to rank thecontingencies
4. Understand need of state estimation and study simple algorithms for stateestimation
5. Study voltage instabilityphenomenon

MODULE-I **(11 Hours)**

Load flow**:** Overview of Newton-Raphson, Gauss-Siedelfast decoupled methods, convergence properties, sparsity techniques, handling Q- max violations in constant matrix, inclusion in frequencyeffects AVR in load flow, handling of discrete variable in loadflow. Fault Analysis**:** Simultaneousfaults, open conductorsfaults, generalized method of faultanalysis.

MODULE-II **(11 Hours)**

Security Analysis: Security state diagram, contingency analysis, generator shift distributionfactorsline outage distribution factor, multiple lineoutages, overload indexranking Power System Equivalents: WARD, REI equivalents.

MODULE-III **(10 Hours)**

State Estimation: Sources of errors inmeasurement, Virtual andPseudo, Measurement, Observability, Tracking stateestimation, WSL method, bad datacorrection.

MODULE-IV **(10 Hours)**

Voltage Stability: Voltagecollapse, P-V curve, multiple power flowsolution, continuation power flow, optimal multiplies loadflow, voltage collapse proximityindices.

Suggested reading

1. J.J. Grainger &W.D. Stevenson, “Power system analysis”, McGraw Hill ,2003
2. A. R. Bergen & Vijay Vittal, “Power System Analysis”, Pearson ,2000
3. L.P. Singh, “Advanced Power System Analysis and Dynamics”, New Age International,2006
4. G.L. Kusic, “Computer aided power system analysis”, Prentice Hall India,1986
5. A.J. Wood, “Power generation, operation and control” , John Wiley,1994

6. P.M. Anderson, "Faulted power system analysis", IEEE Press ,1995

Course outcomes-

Students will be able to:

1. Able to calculate voltage phasors at all buses, given the data using various methods of loadflow
2. Able to calculate fault currents in eachphase
3. Rank various contingencies according to their severity
4. Estimate the bus voltage phasors given various quantities viz. power flow, voltages, taps, CB status etc
5. Estimate closeness to voltage collapse and calculate PV curves using continuation powerflow

PSC102	Power System Dynamics-I	3-0-0	Credits 3

Course Objectives: -

Students will be able to:

1. Study of system dynamics and its physical interpretation
2. Development of mathematical models for synchronous machine
3. Modeling of inductionmotor

MODULE-I **(11 Hours)**

Synchronous Machines: Per unit systems, Park's Transformation (modified), Flux-linkage equations. Voltage and current equations, Formulation of State-space equations, Equivalent circuit.

MODULE-II **(11 Hours)**

Sub-transient and transient inductance and Time constants, Simplified models of synchronous machines, Small signal model: Introduction to frequency model.

MODULE-III **(10 Hours)**

Excitation systems and Philips-Heffron model, PSS Load modeling.

MODULE-IV **(10 Hours)**

Modeling of Induction Motors, Prime mover controllers.

Suggested reading: -

1. P. M. Anderson & A. A. Fouad, "Power System Control and Stability", Galgotia, New Delhi, 1981.

2. J Machowski, J Bialek & J. R W. Bumby, "Power System Dynamics and Stability", John Wiley & Sons, 1997.
3. P. Kundur, "Power System Stability and Control", McGraw Hill Inc., 1994.
4. E.W. Kimbark, "Power system stability", Vol. I & III, John Wiley & Sons, New York, 2002.

Course Outcomes:

Students will be able to:

1. Understand the modeling of synchronous machine indetails
2. Carry out simulation studies of power system dynamics using MATLAB-SIMULINK, MI POWER
3. Carry out stability analysis with and without power system stabilizer (PSS)
4. Understand the load modeling in powersystem

PSE101	Renewable Energy System	3-0-0	Credits 3

Course Objectives: -

Students will be able to:

1. To learn various renewable energysources
2. To gain understanding of integrated operation of renewable energysources
3. To understand Power Electronics Interface with theGrid.

MODULE-I **(8 Hours)**

Introduction, Distributed vs Central Station Generation, Sources of Energy such as Micro-turbines, Internal Combustion Engines.

MODULE-II **(12 Hours)**

Introduction to Solar Energy, Wind Energy, Combined Heat and Power, Hydro Energy, Tidal Energy, Wave Energy, Geothermal Energy, Biomass and Fuel Cells. Power Electronic Interface with theGrid.

MODULE-III **(12 Hours)**

Impact of Distributed Generation on the PowerSystem, Power Quality Disturbances, Transmission System Operation, Protection of Distributed Generators.

MODULE-IV **(8 Hours)**

Economics of Distributed Generation, Case Studies.

Suggested reading

1. RanjanRakesh, Kothari D.P, Singal K.C, "Renewable Energy Sources and Emerging Technologies", 2nd Ed. Prentice Hall of India, 2011.
2. Math H. Bollen, Fainan Hassan, "Integration of Distributed Generation in the Power System", July, 2011, Wiley –IEEE Press
3. Loi Lei Lai, Tze Fun Chan, "Distributed Generation: Induction and Permanent Magnet Generators", October 2007, Wiley-IEEE Press.
4. Roger A. Messenger, Jerry Ventre, "Photovoltaic System Engineering", 3rd Ed, 2010.
5. James F. Manwell, Jon G. McGowan, Anthony L Rogers, "Wind energy explained: Theory Design and Application", John Wiley and Sons 2nd Ed, 2010.

Course Outcomes: - Students will be able to:

1. Knowledge about renewableenergy
2. Understand the working of distributed generation system in autonomous/grid connectedmodes
3. Know the Impact of Distributed Generation on PowerSystem.

PSE102	Smart Grids	3-0-0	Credits 3

Course Objectives: - Students will be able to:

1. Understand concept of smart grid and its advantages over conventionalgrid
2. Know smart meteringtechniques
3. Learn wide area measurementtechniques
4. Understanding the problems associated with integration of distributed generation & its solution through smartgrid.

MODULE-I **(8 Hours)**

Introduction to Smart Grid, Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Concept of Robust &Self Healing Grid Present development & International policies in SmartGrid.

MODULE-II **(12 Hours)**

Introduction to Smart Meters, Real Time Prizing, Smart Appliances, Automatic Meter Reading (AMR), Outage Management System (OMS), Plug in Hybrid Electric Vehicles (PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation, Smart Substations, Substation Automation, Feeder Automation Geographic InformationSystem (GIS), Intelligent Electronic Devices (IED) & their application for monitoring & protection, Smart storage like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System (WAMS) ,Phase Measurement Unit (PMU).

MODULE-III **(11 Hours)**

Concept of micro-grid, need & applications of micro-grid, formation of micro-grid, Issues of interconnection, protection & control of micro-grid, Plastic & Organic solar cells, Thin film solar cells, Variable speed wind generators, fuel-cells,micro-turbines, Captive power plants, Integration of renewable energysource, Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable EnergySources, Power Quality Conditioners for Smart Grid, Web based Power Qualitymonitoring, Power Quality Audit.

MODULE-IV **(11 Hours)**

Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Neighborhood Area Network (NAN), Wide Area Network (WAN), Bluetooth, ZigBee, GPS, Wi-Fi, Wi-Max based communication, Wireless Mesh Network, Basics of CLOUD Computing & Cyber Security for Smart Grid, Broadband over Power line (BPL), IP based protocols.

Suggested reading

1. Ali Keyhani, "Design of smart power grid renewable energy systems", Wiley IEEE, 2011
2. Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response", CRC Press, 2009
3. Janaka Ekanayake, Nick Jenkins, KithsiriLiyanage, "Smart Grid: Technology and Applications", Wiley2012
4. Stuart Borlase, "Smart Grid: Infrastructure, Technology and solutions "CRC Press
5. A.G. Phadke, "Synchronized Phasor Measurement and their Applications", Springer.

Course Outcomes

Students will be able to:

1. Appreciate the difference between smart grid & conventionalgrid
2. Apply smart metering concepts to industrial and commercialinstallations
3. Formulate solutions in the areas of smart substations, distributed generation and wide area measurements
4. Come up with smart grid solutions using modern communication technologies.

PSE103	High Power Converters	3-0-0	Credits 3

Course Objectives: - Students will be able to:

1. Understand the requirements of high power ratedconverters
2. Understand the different topologies involved for theseconverters
3. Able to understand the design of protection circuits for theseconverters

MODULE-I **(10 Hours)**

Power electronic systems, An overview of PSDs, multipulse diode rectifier, multipulse, SCR rectifier.

MODULE-II **(11 Hours)**

Phase shifting transformers, multilevel voltage source inverters: two level voltage source inverter, Cascaded, H bridge multilevelinverter, Diode clamped multilevel inverters, flying capacitor multilevelinverter.

MODULE-III **(11 Hours)**

PWM current source inverters, DC to DC switch mode converters, AC voltage controllers: Cyclo- converters, matrix converter, Power conditioners and UPS.

MODULE-IV **(10 Hours)**

Design aspects of converters, protection of devices and circuits.

Suggested reading

1. N. Mohan, T. M. Undeland and W. P. Robbins, "Power Electronics: Converter, Applications and Design", John Wiley and Sons, 1989.
2. M.H. Rashid, "Power Electronics", Prentice Hall of India, 1994.
3. B. K. Bose, "Power Electronics and A.C. Drives", Prentice Hall, 1986.
4. Bin Wu, "High power converters and drives", IEEE press, Wiley Enterscience.

Course Outcomes: -

Students will be able to:

1. Learn the characteristics of PSDs such as SCRs, GTOs, IGBTs and use them in practicalsystems
2. Knowledge of working of multi-level VSIs, DC-DC switched mode converters, cyclo-converters and PWM techniques and the ability to use them properly
3. Acquire knowledge of power conditioners and their applications
4. Ability to design power circuit and protection circuit of PSDs and converters

PSE104	Electrical Power Distribution System	3-0-0	Credits 3

Course Objectives: -Students will be able to:

1. Learning about power distributionsystem
2. Learning of SCADASystem

3. DistributionAutomation

MODULE-I **(11 Hours)**

Distribution of Power, Management, PowerLoads, Load Forecasting Short-term &Long-term, Power System Loading, Technological Forecasting, Advantages of DistributionManagement System (D.M.S.) Distribution Automation: Definition, Restoration / Reconfiguration of Distribution Network, Different Methods andConstraint, Power FactorCorrection.

MODULE-II **(11 Hours)**

Interconnection of Distribution, Control & CommunicationSystems, Remote Metering, Automatic Meter Reading and itsimplementation, SCADA: Introduction, BlockDiagram, SCADA Applied to Distribution Automation, Common Functions of SCADA, Advantages of Distribution Automation throughSCADA.

MODULE-III **(10 Hours)**

Calculation of Optimum Number of Switches, Capacitors, Optimum Switching Device Placement in Radial, Distribution Systems, Sectionalizing Switches – Types, Benefits, Bellman's OptimalityPrinciple, Remote Terminal Units, Energy efficiency in electrical distribution & Monitoring.

MODULE-IV **(10 Hours)**

Maintenance of Automated Distribution Systems, Difficulties in Implementing Distribution, Automation in Actual Practice, Urban/Rural Distribution, Energy Management, AI techniques applied to Distribution Automation.

Suggested reading

1. A.S. Pabla, "Electric Power Distribution", Tata McGraw Hill Publishing Co. Ltd., Fourth Edition.
2. M.K. Khedkar, G.M. Dhole, "A Text Book of Electrical power Distribution Automation", University Science Press, New Delhi.
3. Anthony J Panseni, "Electrical Distribution Engineering", CRCPress.
4. James Momoh, "Electric Power Distribution, automation, protection & control", CRC Press.

Course Outcomes: -Students will be able to:

1. Knowledge of power distributionsystem
2. Study of Distribution automation and its application inpractice
3. To learn SCADAsystem

PSE105	Pulse Width Modulation for PE Converters	3-0-0	Credits 3

Course Objectives: -Students will be able to:

1. To understand Necessity and Importance of PWMtechniques
2. Implementation of PWM controllers

MODULE-I **(11 Hours)**

Introduction to PE converters Modulation of one inverter phaselag, Modulation of singlephase VSI and 3 phase VSI, Zero space vector placement modulationstrategies, Losses-Discontinuousmodulation, Modulation of CSI.

MODULE-II **(11 Hours)**

Over modulation ofconverters, programme modulationstrategies Pulse width modulation for multilevei inverters, Implementation of modulationcontroller.

MODULE-III **(10 Hours)**

Continuing developments in modulation as randomPWM, PWM for voltageunbalance.

MODULE-IV **(10 Hours)**

Effect of minimum pulse width and deadtime

Suggested reading

1. D. Grahame Holmes, Thomas A. Lipo, "Pulse width modulation of Power Converter: Principles and Practice", John Wiley & Sons,03-Oct-2003
2. Bin Vew, "High Power Converter", WileyPublication
3. Marian K. Kazimicrczuk, "Pulse width modulated dc-dc power converter", WileyPublication

Course Outcomes: -Students will be able to:

1. Appreciate importance of PWM techniques
2. Implement PWM using different strategies
3. Control CSI and VSI using PWM
4. Compare performance of converter for different PWM techniques

PSE106	Electric and Hybrid Vehicles	3-0-0	Credits 3

Course Objectives: -Students will be able to:

1. To understand upcoming technology of hybridsystem
2. To understand different aspects of drivesapplication
3. Learning the electricTraction.

MODULE-I **(11 Hours)**

History of hybrid and electric vehicles, Social and environmental importance of hybrid and electricvehiclesImpact of modern drive-trains on energysupplies, Basics of vehicle performance, vehicle power source characterization Transmissioncharacteristics, models to describe vehicleperformance.

MODULE-II **(11 Hours)**

Basic concept of hybridtraction, Introduction to various hybrid drive-traintopologies, Power flow control in hybrid drive-train topologies, Fuel efficiency analysis, Basic concept of hybrid traction, Introduction to various hybrid drive-traintopologies, Power flow control in hybrid drive-traintopologies, Fuel efficiencyanalysis.

MODULE-III **(10 Hours)**

Introduction to electric components used in hybrid and electric vehicle, Configuration and control of DC Motordrives, Configuration and control of Introduction Motor drives configuration and control of Permanent Magnet Motor drives Configuration and control of Switch Reluctance, Motor drives, drive system efficiency

MODULE-IV **(10 Hours)**

Matching the electric machine and the internal combustion engine (ICE) Communications, supportingsubsystems, Introduction to energy management and their strategies used in hybrid and electric vehicle Classification of different energy management strategies Comparison of different energy management strategies Implementation issues of energystrategies.

Suggested reading

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
2. MehrdadEhsani, yimiGao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
3. James Larminie, John Lowry, Electric vehicle Technology Explained, Wiley 2003.

Course Outcomes

Students will be able to

1. Acquire knowledge about fundamental concepts, principles, analysis and design of hybrid and electricvehicles.
2. Learn electric drive in vehicles /traction.

PSC103	Power System Lab	0-0-4	Credits 2

List of Experiments:

1. Determination of ABCD parameters of a long transmission line.
2. Study of Ferranti effect.
3. Study of Buchholtz relay.
4. Study of SCADA monitoring system of a power system.
5. Study of IDMT relay.
6. Study of a photo voltaic analyzer.
7. Simulation of automatic load frequency control of 1-area and 2- area systems.
8. Development of Ybus matrix of a IEEE-14 bus power system using MATLAB simulation.
9. Shunt reactor compensation for unloaded transmission line.
10. Shunt capacitor compensation of a transmission line.
11. Power system fault studies using distance relay and short circuit relay.

*Any other experiments if found suitable, however the total number of experiments should not be less than 8.

PSC104	Renewable Energy Lab	0-0-4	Credits 2

1. Power Curves
2. Build a Wind Farm
3. Test the Capabilities of the Hydrogen Fuel Cells and Capacitors
4. Effect of Temperature on Solar Panel Output
5. Variables Affecting Solar Panel Output
6. Wind Turbine Output: The Effect of Load
7. Test the Capabilities of Solar Panels and Wind Turbines

GHM101	Research Methodology & Intellectual Property Rights	2-0-0	Credits 2

MODULE-I **(06 Hours)**

Meaning of research problem, Sources of research problem, Criteria characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.

Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

MODULE-II **(04 Hours)**

Effective literature studies approaches, analysis,

Plagiarism, Research ethics.

MODULE-III **(04 Hours)**

Effective technical writing, how to write report, Paper.

Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

MODULE-IV **(06 Hours)**

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

MODULE-V **(04 Hours)**

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

MODULE-VI **(04 Hours)**

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Text/Reference Books:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science& engineering students'".
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.

5. Mayall, “Industrial Design”, McGraw Hill, 1992.
6. Niebel, “Product Design”, McGraw Hill, 1974.
7. Asimov, “Introduction to Design”, Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “Intellectual Property in New Technological Age”, 2016.
9. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008

Course Outcomes: At the end of the course, students will be able to

1. Understand research problem formulation.
2. Analyze research related information
3. Follow research ethics
4. Understand that today’s world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property.

   Right to be promoted among students in general & engineering in particular.
6. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Audit Courses

AHM101	English for Research Paper Writing	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Understand that how to improve your writing skills and level of readability
2. Learn about what to write in each section
3. Understand the skills needed when writing a Title

   Ensure the good quality of paper at very first-time submission

MODULE-I **(4 Hours)**

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

MODULE-II **(4 Hours)**

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction.

MODULE-III **(4 Hours)**

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

MODULE-IV **(4 Hours)**

key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed whenwriting a Review of the Literature.

MODULE-V **(4 Hours)**

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions.

MODULE-VI **(4 Hours)**

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

Suggested Studies:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book.

4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

ACE101	Disaster Management	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

MODULE-I **(4 Hours)**

Introduction

Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

MODULE-II **(4 Hours)**

Repercussions of Disasters and Hazards:

Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem.

Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

MODULE-III **(4 Hours)**

Disaster Prone Areas in India

Study of Seismic Zones; Areas Prone to Floods And Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics

MODULE-IV **(4 Hours)**

Disaster Preparedness and Management

Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, Media Reports: Governmental and

Community Preparedness.

MODULE-V **(4 Hours)**

Risk Assessment

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategiesfor Survival.

MODULE-VI **(4 Hours)**

Disaster Mitigation

Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation In India.

Text / Reference Books:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies, New Royal book Company.
2. Sahni, Pardeep Et. Al. (Eds.)," Disaster Mitigation Experiences and Reflections", Prentice Hall of India, New Delhi.
3. Goel S. L., Disaster Administration and Management Text And Case Studies", Deep &Deep Publication Pvt. Ltd., New Delhi.

AHM102	Sanskrit for Technical Knowledge	2-0-0	Credits 0

Course Objectives:

1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. Learning of Sanskrit to improve brain functioning
3. Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power
4. The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature

MODULE-I **(8 Hours)**

- Alphabets in Sanskrit
- Past/Present/Future Tense
- Simple Sentences

MODULE-II **(8 Hours)**

- Order
- Introduction of roots
- Technical information about Sanskrit Literature

MODULE-III **(8 Hours)**

- Technical concepts of Engineering-Electrical, Mechanical,Architecture, Mathematics

Suggested reading:

1. "Abhyaspustakam" – Dr. Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

Course Output: Students will be able to

1. Understanding basic Sanskrit language
2. Ancient Sanskrit literature about science & technology can be understood
3. Being a logical language will help to develop logic in students

AHM103	Value Education	2-0-0	Credits 0

Course Objectives: Students will be able to

1. Understand value of education and self- development
2. Imbibe good values in students
3. Know about the importance of character

MODULE-I **(6 Hours)**

- Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism.
- Moral and non- moral valuation. Standards and principles.
- Value judgements

MODULE-II **(6 Hours)**

- Importance of cultivation of values.
- Sense of duty.Devotion, Self-reliance.Confidence, Concentration. Truthfulness, Cleanliness.
- Honesty, Humanity.Power of faith, National Unity.
- Patriotism.Love for nature, Discipline

MODULE-III **(6 Hours)**

- Personality and Behavior Development - Soul and Scientific attitude.
- Positive Thinking. Integrity and discipline.
- Punctuality, Love and Kindness.
- Avoid fault Thinking.
- Free from anger, Dignity of labour.
- Universal brotherhood and religious tolerance.
- True friendship.
- Happiness Vs suffering, love for truth.
- Aware of self-destructive habits.
- Association and Cooperation.
- Doing best for saving nature

MODULE-IV **(6 Hours)**

- Character and Competence –Holy books vs Blind faith.
- Self-management and Good health.
- Science of reincarnation.
- Equality, Nonviolence, Humility, Role of Women.
- All religions and same message.
- Mind your Mind, Self-control.
- Honesty, Studying effectively

Text / Reference Books

1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

Course outcomes: Students will be able to

1. Knowledge of self-development

2. Learn the importance of Human values
3. Developing the overall personality

AHM104	Constitution of India	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutionalrole and entitlement to civil and economic rights as well as the emergence of nationhood inthe early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the BolshevikRevolution in 1917 and its impact on the initial drafting of the Indian Constitution.

MODULE-I **(4 Hours)**

- **History of Making of the Indian Constitution:**

  History

  Drafting Committee, (Composition& Working)

MODULE-II **(4 Hours)**

- **Philosophy of the Indian Constitution:**

  Preamble

  Salient Features

MODULE-III **(4 Hours)**

- **Contours of Constitutional Rights & Duties:**

  Fundamental Rights

  Right to Equality

  Right to Freedom

  Right against Exploitation

  Right to Freedom of Religion

  Cultural and Educational Rights

  Right to Constitutional Remedies

  Directive Principles of State Policy

Fundamental Duties.

MODULE-IV **(4 Hours)**

- **Organs of Governance:**

  Parliament

  Composition

  Qualifications and Disqualifications

  Powers and Functions

  Executive

  President

  Governor

  Council of Ministers

  Judiciary, Appointment and Transfer of Judges, Qualifications

  Powers and Functions

MODULE-V **(4 Hours)**

- **Local Administration:**

  District's Administration head: Role and Importance,

  Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation.

  Pachayati raj: Introduction, PRI: ZilaPachayat.

  Elected officials and their roles, CEO ZilaPachayat: Position and role.

  Block level: Organizational Hierarchy (Different departments),

  Village level: Role of Elected and Appointed officials,

  Importance of grass root democracy

  Model Curriculum of Engineering & Technology PG Courses [Volume -II]

MODULE-VI **(4 Hours)**

- **Election Commission:**

  Election Commission: Role and Functioning.

  Chief Election Commissioner and Election Commissioners.

  State Election Commission: Role and Functioning.

  Institute and Bodies for the welfare of SC/ST/OBC and women.

Text / Reference Books:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Outcomes: Students will be able to:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the passage of the Hindu Code Bill of 1956.

AHM105	Pedagogy Studies	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Review existing evidence on the review topic to inform programme design and policymaking undertaken by the DfID, other agencies and researchers.
2. Identify critical evidence gaps to guide the development.

MODULE-I **(4 Hours)**

- **Introduction and Methodology:**
- Aims and rationale, Policy background, Conceptual framework and terminology
- Theories of learning, Curriculum, Teacher education.
- Conceptual framework, Research questions**.**
- Overview of methodology and Searching.

MODULE-II **(2 Hours)**

- Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries.
- Curriculum, Teacher education.

MODULE-III **(4 Hours)**

- Evidence on the effectiveness of pedagogical practices
- Methodology for the in depth stage: quality assessment of included studies.
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?
- Theory of change.
- Strength and nature of the body of evidence for effective pedagogical practices.
- Pedagogic theory and pedagogical approaches.
- Teachers' attitudes and beliefs and Pedagogic strategies.

MODULE-IV **(4 Hours)**

- Professional development: alignment with classroom practices and follow up support
- Peer support
- Support from the head teacher and the community.
- Curriculum and assessment
- Barriers to learning: limited resources and large class sizes

MODULE-V **(2 Hours)**

- **Research gaps and future directions**
- Research design
- Contexts
- Pedagogy
- Teacher education
- Curriculum and assessment
- Dissemination and research impact.

Text / Reference Books:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2):245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal ofCurriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International JournalEducational

Development, 33 (3): 272–282.

5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

Course outcomes: Students will be able to understand:

1. What pedagogical practices are being used by teachers in formal and informal classrooms indeveloping countries?
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, andwith what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

AHM106	Stress Management by Yoga	2-0-0	Credits 0

Course Objectives:

1. To achieve overall health of body and mind
2. To overcome stress

MODULE-I **(8 Hours)**

- Definitions of Eight parts of yoga. (Ashtanga)

MODULE-II **(8 Hours)**

- Yam and Niyam.

  Do`s and Don't's in life.

  i) Ahinsa, satya, astheya, bramhacharya and aparigraha

  ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

MODULE-III **(8 Hours)**

- Asan and Pranayam

  i) Various yog poses and their benefits for mind & body

  ii) Regularization of breathing techniques and its effects-Types of pranayam

Text / Reference Books:

1. 'Yogic Asanas for Group Tarining-Part-I" :Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

Course outcomes: Students will be able to:

1. Develop healthy mind in a healthy body thus improving social health also
2. Improve efficiency

AHM107	Personality Development through Life Enlightenment Skills	2-0-0	Credits 0

Course Objectives:

1. To learn to achieve the highest goal happily
2. To become a person with stable mind, pleasing personality and determination
3. To awaken wisdom in students

MODULE-I **(8 Hours)**

Neetisatakam-Holistic development of personality

- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)
- Verses- 52,53,59 (dont's)
- Verses- 71,73,75,78 (do's)

MODULE-II **(8 Hours)**

Approach to day to day work and duties.

- Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48,
- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,
- Chapter 18-Verses 45, 46, 48.

MODULE-III **(8 Hours)**

Statements of basic knowledge.

- Shrimad Bhagwad Geeta: Chapter 2-Verses 56, 62, 68
- Chapter 12 - Verses 13, 14, 15, 16,17, 18
- Personality of Role model. Shrimad Bhagwad Geeta: Chapter 2-Verses 17, Chapter 3-Verses 36,37,42,
- Chapter 4- Verses 18, 38,39
- Chapter 18 – Verses 37,38,63

Text / Reference Books:

1. "Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

Course outcomes: Students will be able to:

1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity
3. Study of Neetishatakam will help in developing versatile personality of students.

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

M.TECH SYLLABUS for *Specialization*: POWER SYSTEM ENGINEERING

BRANCH: ELECTRICAL ENGINEERING (2018-19 Admission Batch)

2nd Semester

PSC201	Digital Protection of Power System	3-0-0	Credits 3

Course Objectives: -Students will be able to:

1. Study of numericalrelays
2. Developing mathematical approach towards protection
3. Study of algorithms for numerical protection

MODULE-I **(10 Hours)**

Evolution of digital relays from electromechanical relays, Performance and operational characteristics of digitalprotection, Mathematical background to protection algorithms, Finite differencetechniques.

MODULE-II **(10 Hours)**

Interpolationformulae, Forward, backward and central differenceinterpolation, Numericaldifferentiation, Curve fitting andsmooth in, Least squaresmethod, Fourieranalysis, Fourier series and Fouriertransform, Walsh functionanalysis.

MODULE-III **(11 Hours)**

Basic elements of digital protection, Signal conditioning: transducers, surge protection, analog filtering, analog multiplexers, Conversion subsystem: the sampling theorem, signalaliasing, Error, sample and hold circuits, multiplexers, analogto digital conversion, Digital filteringconcepts, The digital relay as a unit consisting of hardware andsoftware.

MODULE-IV **(11 Hours)**

Sinusoidal wave based algorithms, Sample and first derivative (Mann and Morrison) algorithm,

Fourier and Walsh based algorithms**,** Fourier Algorithm: Full cycle window algorithm, fractional cycle window algorithm, Walsh function based algorithm, Least Squares based algorithms, Differential equation basedalgorithms, Traveling Wave based Techniques, Digital Differential Protection of Transformers, Digital Line Differential Protection, Recent Advances in Digital Protection of Power Systems.

Suggested reading

1. A.G. Phadke and J. S. Thorp, "Computer Relaying for Power Systems", Wiley/Research studies Press,2009
2. A.T. Johns and S. K. Salman, "Digital Protection of Power Systems", IEEEPress,1999
3. Gerhard Zeigler, "Numerical Distance Protection", Siemens Publicis Corporate Publishing, 2006
4. S.R. Bhide "Digital Power System Protection" PHI LearningPvt.Ltd.2014

Course Outcomes: -

Students will be able to:

1. Learn the importance of DigitalRelays
2. Apply Mathematical approach towardsprotection
3. Learn to develop various Protectionalgorithms

PSC202	Power System Dynamics-II	3-0-0	Credits 3

Course Objectives: -Students will be able to:

1. Study of power systemdynamics
2. Interpretation of power system dynamicphenomena
3. Study of various forms ofstability

MODULE-I **(11 Hours)**

Basic Concepts of Dynamic Systems and Stability Definition, Small Signal Stability (Low Frequency Oscillations) of Unregulated and Regulated System, Effect of Damper, Flux Linkage Variation and AVR.

MODULE-II **(11 Hours)**

Large Signal Rotor AngleStability, Dynamic Equivalents AndCoherency, Direct Method of StabilityAssessment, Stability EnhancingTechniques, Mitigation Using Power SystemStabilizer.

MODULE-III **(10 Hours)**

Asynchronous Operation and Resynchronization, Multi-Machine Stability, Dynamic Analysis of Voltage Stability, Voltage Collapse.

MODULE-IV **(10 Hours)**

FrequencyStability, Automatic GenerationControl, Primary and Secondary Control, Sub-Synchronous Resonance and CounterMeasures.

Suggested reading

1. P. Kundur, “Power System Stability and Control”, McGraw Hill Inc,1994
2. J. Machowski, Bialek, Bumby, “Power System Dynamics and Stability”, John Wiley & Sons, 1997
3. L. Leonard Grigsby (Ed.); “Power System Stability and Control”, Second edition, CRC Press, 2007
4. V. Ajjarapu, “Computational Techniques for voltage stability assessment & control”; Springer,

2006/

Course Outcomes: -

Students will be able to:

1. Gain valuable insights into the phenomena of power system including obscureones.
2. Understand the power system stabilityproblem.
3. Analyze the stability problems and implement modern controlstrategies.
4. Simulate small signal and large signal stabilityproblems.

PSE201	Restructured Power Systems	3-0-0	Credits 3

Course Objectives: -Students will be able to:

1. Understand what is meant by restructuring of the electricitymarket
2. Understand the need behind requirement for deregulation of the electricitymarket
3. Understand the money, power & information flow in a deregulated powersystem

MODULE-I **(11 Hours)**

Fundamentals of restructured system Market, architecture, Load elasticity, Social welfare maximization, OPF: Role in vertically integrated systems and in restructured markets, congestion management.

MODULE-II **(10 Hours)**

Optimalbidding, Riskassessment, Hedging, Transmissionpricing, Tracing ofpower.

MODULE-III **(11 Hours)**

Ancillaryservices, Standard marketdesign, Distributed generation in restructuredmarkets, Developments inIndia, IT applications in restructuredmarkets.

MODULE-IV **(10 Hours)**

Working of restructured power systems, PJM, Recent trends in Restructuring.

Suggested reading

1. Lorrin Philipson, H. Lee Willis, "Understanding electric utilitiesand de-regulation", Marcel DekkerPub., 1998.
2. Steven Stoft, "Power system economics: designing markets for electricity", John Wiley and Sons, 2002.
3. KankarBhattacharya, Jaap E. Daadler, Math H.J. Boolen, "Operation of restructured power systems",

Kluwer Academic Pub., 2001.

4. Mohammad Shahidehpour, MuwaffaqAlomoush, "Restructured electrical power systems: operation, trading and volatility", Marcel Dekker.

Course Outcomes: -Students will be able to:

1. Describe various types of regulations in powersystems.
2. Identify the need of regulation andderegulation.
3. Define and describe the Technical and Non-technical issues in Deregulated PowerIndustry.
4. Identify and give examples of existing electricitymarkets.
5. Classify different market mechanisms and summarize the role of various entities in themarket.

PSE202	Advanced Digital Signal Processing	3-0-0	Credits 3

Course Objectives: -Students will be able to:

1. To understand the difference between discrete-time and continuous-timesignals
2. To understand and apply Discrete Fourier Transforms (DFT)

MODULE-I **(10 Hours)**

Discrete timesignals**,** Linear shift invariantsystems-**,**Stability andcausality**,** Sampling of continuous timesignals, Discrete time Fourier transform- Discrete Fourier series- Discrete Fourier transfor, Z transform-Properties of differenttransforms.

MODULE-II **(11 Hours)**

Linear convolution usingDFT**,** Computation of DFT Design of IIR digital filters from analogfilters**,** Impulse invariancemethod**,** Bilinear transformationmethod**,** FIR filter design using windowfunctions**,** Comparison of IIR and FIR digitalfilters**,** Basic IIR and FIR filter realizationstructures**,** Signal flow graph representations Quantization process anderrors**,** Coefficient quantisation effects in IIR and FIRfilters.

MODULE-III **(11 Hours)**

A/D conversion noise- Arithmetic round-offerrors, Dynamic rangescaling, Overflow oscillations and zero Input limit cycles in IIRfilters, Linear SignalModels, All pole, All zero and Pole-zeromodels, Power spectrum estimation- Spectral analysis of deterministicsignals, Estimation of power spectrum of stationary randomsignals

MODULE-IV **(10 Hours)**

Optimum linearfilters, Optimum signalestimation, Mean square errorestimation, Optimum FIR and IIRFilters

Suggested reading

1. Sanjit K Mitra, "Digital Signal Processing: A computer-based approach", Tata McGraw-Hill Edition 1998
2. Dimitris G. Manolakis, VinayK. Ingle and Stephen M. Kogon, "Statistical and Adaptive Signal Processing", Mc Grow Hill international editions. -2000

Course Outcomes: -

Students will be able to:

1. Knowledge about the time domain and frequency domain representations as well analysis of discrete time signals andsystems
2. Study the design techniques for IIR and FIR filters and their realizationstructures.
3. Acquire knowledge about the finite word length effects in implementation of digitalfilters.
4. Knowledge about the various linear signal models and estimation of power spectrum of stationary randomsignals
5. Design of optimum FIR and IIRfilters

PSE203	Power Apparatus Design	3-0-0	Credits 3

Course Objectives: -Students will be able to:

1. Study the modelling analysis of rotatingmachine.
2. Learning electromagnetic energyconversion
3. To know about rating ofmachines.

MODULE-I **(11 Hours)**

Principles of Design of Machines -Specific loadings, choice of magnetic and electricloadings,

Real and apparent flux densities, temperature rise calculation, Separation of main dimension for DCmachines, Induction machines and synchronousmachines, Design of Transformers-General considerations, output equation, emf per turn, choice of flux density and current density, main dimensions, leakage reactance and conductor size, design of tank and cooling.

MODULE-II **(10 Hours)**

Specific loadings, choice of magnetic and electric loadings Real and apparent flux -densities, temperature risecalculation, Separation of main dimension for DC machines, Induction machines and synchronous machines, Heating and cooling of machines, types of ventilation continuous and intermittentrating.

MODULE-III **(11 Hours)**

General considerations, output equation, emf per turn, choice of flux density and current density, main dimensions, leakage reactance and conductor size, design of tank and coolingtubes, Calculation of losses, efficiency and regulation, Forces winding during shortcircuit General considerations, outputequation, Choice of specific electric and magnetic loadings, efficiency, powerfactor, Number of slots in stator androtor, Elimination of harmonictorques.

MODULE-IV **(10 Hours)**

Design of stator and rotor winding, slot leakage flux, Leakage reactance, equivalent resistance of squirrel cage rotor, Magnetizing current, efficiency from design data Types of alternators, comparison, specific loadings, output co-efficient, design of main dimensions, Introduction to Computer Aided Electrical Machine Design Energy efficientmachines

Suggested reading

1. Clayton A.E, "The Performance and Design of D.C. Machines", Sir I. Pitman & sons, Ltd.
2. M.G. Say, "The Performance and Design of A.C. Machines", Pitman
3. SawhneyA.K, "A course in Electrical Machine Design", DhanpatRai& Sons, 5th Edition

Course Outcomes: -

Students will be able to:

1. To give a systematic approach for modeling and analysis of all rotating machines under both transient and steady state conditions with the dimensions and materialused
2. Ability to model and design all types of rotation machines including specialmachines

PSE204	SCADA System and Applications	3-0-0	Credits 3

Course Objectives: -Students will be able to:

1. To understand what is meant by SCADA and itsfunctions
2. To know SCADAcommunication
3. To get an insight into itsapplication

MODULE-I **(10 Hours)**

Introduction to SCADA, Data acquisition systems, Evolution of SCADA, Communication technologies Monitoring and supervisory functions, SCADA applications in Utility Automation, Industries SCADA

MODULE-II **(11 Hours)**

Industries SCADA SystemComponents, Schemes- Remote Terminal Unit (RTU), Intelligent Electronic Devices (IED), Programmable Logic Controller (PLC), Communication Network, SCADA Server, SCADA/HMI Systems.

MODULE-III **(11 Hours)**

SCADA Architecture, Various SCADA architectures, advantages and disadvantages of each system, single unified standard architecture -IEC 61850, SCADA Communication various industrial communication technologies, wired and wireless methods and fiberoptics, Open standard communication protocols.

MODULE-IV **(10 Hours)**

SCADA Applications: Utility applications, Transmission and Distribution sector operations, monitoring, analysis and improvement, Industries - oil, gas andwater Casstudies, Implementation, Simulation Exercises.

Suggested reading

1. Stuart A. Boyer: "SCADA-Supervisory Control and Data Acquisition", Instrument Society of America Publications, USA, 2004.
2. Gordon Clarke, Deon Reynders: "Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems", Newnes Publications, Oxford, UK, 2004.
3. William T. Shaw, "Cybersecurity for SCADA systems", PennWell Books, 2006.
4. David Bailey, Edwin Wright, "Practical SCADA for industry", Newnes, 2003.
5. Michael Wiebe, "A guide to utility automation: AMR, SCADA, and IT systems for electric power", PennWell 1999.

Course Outcomes: -

Students will be able to:

1. Describe the basic tasks of Supervisory Control Systems (SCADA) as well as their typical applications
2. Acquire knowledge about SCADA architecture, various advantages and disadvantages of each system
3. Knowledge about single unified standard architecture IEC 61850
4. To learn about SCADA system components: remote terminal units, PLCs, intelligent electronic devices, HMI systems, SCADA server
5. Learn and understand about SCADA applications in transmission and distribution sector, industries etc

PSE205	Power Quality	3-0-0	Credits 3

Course Objectives: -Students will be able to:

1. Understand the different power quality issues to beaddressed
2. Understand the recommended practices by various standard bodies like IEEE, IEC, etc on voltage& frequency, harmonics
3. Understanding STATIC VARCompensators

MODULE-I **(11 Hours)**

Introduction-power quality-voltage quality-overview of power quality phenomena, classification of power quality issues-power quality measures and standards-THD-TIF-DIN-C, message weights-flicker factor transient phenomena-occurrence of power qualityproblems, power acceptability curves-IEEE guides, standards and recommended practices. Harmonics-individual and total harmonicdistortion, RMS value of a harmonicwaveform, Triplex harmonics important harmonic introducingdevices-SMPS-, Three phase powerconverters-arcing devices saturable devices-harmonic distortion of fluorescent lamps-effect of power system harmonics on power systemequipmentand loads.

MODULE-II **(11 Hours)**

Modeling of network and components under non sinusoidal conditions transmission and distribution systems, Shunt capacitors-transformers-electricmachines-ground, systems loads that cause power qualityproblems, power quality problems created by drives and its impact ondrive Power factor improvement-PassiveCompensation, Passive Filtering, Harmonic, Resonance

Impedance Scan Analysis- Active Power Factor Corrected Single Phase FrontEnd, Control Methods for Single Phase APFC, Three Phase APFC and Control Techniques, PFCBased on Bilateral Single Phase and Three PhaseConverter

MODULE-III **(10 Hours)**

Static VAR compensators-SVC and STATCOM Active Harmonic Filtering-Shunt Injection

Filter for single phase, three-phase three-wire and three-phase four- wire systems, d-q domain control of three phase shunt active filters, uninterruptible power supplies, constantvoltage, transformers, series active power filtering techniques for harmonic cancellation and isolation.

MODULE-IV **(10 Hours)**

Dynamic Voltage Restorers for sag, swell and flicker problems. Grounding and wiringintroduction, NEC grounding requirements-reasons forgrounding, typical grounding and wiring problems solutions to grounding and wiringproblems.

Suggested reading

1. G.T. Heydt, “Electric power quality”, McGraw-Hill Professional,2007
2. Math H. Bollen, “Understanding Power Quality Problems”, IEEE Press,2000
3. J. Arrillaga, “Power System Quality Assessment”, John wiley,2000

4. J. Arrillaga, B.C. Smith, N.R. Watson &A. R.Wood ,"Power system Harmonic Analysis", Wiley, 1997

Course Outcomes: -

Students will be able to:

1. Acquire knowledge about the harmonics, harmonic introducing devices and effect of harmonics on system equipment and loads
2. To develop analytical modeling skills needed for modeling and analysis of harmonics in networks and components
3. To introduce the student to active power factor correction based on static VAR compensators and its control techniques
4. To introduce the student to series and shunt active power filtering techniques for harmonics.

PSE206	Artificial Intelligence Techniques	3-0-0	Credits 3

Course Objectives: -Students will be able to:

1. Understanding fuzzy logic, ANN
2. Understanding GA &EP

MODULE-I **(10 Hours)**

Biological foundations to intelligentSystem, Artificial Neural Networks, Single layer and Multilayer Feed Forward NN, LMS and Back PropagationAlgorithm, Feedback networks and Radial Basis Function, Networks FuzzyLogic, Knowledge Representation and InferenceMechanism, DefuzzificationMethods

MODULE-II **(10 Hours)**

Fuzzy Neural Networks, some algorithms to learn the parameters of the network like GA

MODULE-III **(11 Hours)**

System Identification using Fuzzy and Neural, Network Geneticalgorithm, Reproduction cross over, mutation, Introduction to evolutionaryprogram

MODULE-IV **(10 Hours)**

Applications of above mentioned techniques to practical problems.

Suggested reading

1. J M Zurada, "An Introduction to ANN", Jaico Publishing House

2. Simon Haykins, “Neural Networks”, Prentice Hall
3. Timothy Ross, “Fuzzy Logic with Engg.Applications”, McGraw.Hill
4. Driankov, Dimitra, “An Introduction to Fuzzy Control”, NarosaPublication
5. Golding, “Genetic Algorithms”, Addison-Wesley Publishing Com

Course Outcomes: -

Students will be able to:

1. Learn the concepts of biological foundations of artificial neuralnetworks
2. Learn Feedback networks and radial basis function networks and fuzzylogics
3. Identifications of fuzzy and neural network
4. Acquire the knowledge of GA

PSC203	Power System Lab-II	0-0-4	Credits 2

List of experiments:

1. Introduction to Power System Protection
2. Impact of Induction Motor Starting on Power System
3. Modelling of Differential Relay using MATLAB
4. Radial Feeder Protection
5. Parellel Feeder Protection
6. Principle of Reverse Power Protection
7. Differential Protection of Transformer
8. To the study time vs. voltage characteristcs of over voltage induction relay

PSC204	Power Electronics and Applications Lab	0-0-4	Credits 2

1. Write A Program for Best First Search
2. Write A Program to Generate the output for A* Algorithm.
3. Write a Program to Show the Tic Tac Toe Game for 0 and X.
4. Write A Program for Expert System by Using Forward Chaining.
5. Comparing the Search Methods
6. Implement the Greedy Search Algorithm
7. Implement the min-max Algorithm

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BRANCH: ELECTRICAL ENGINEERING (2018-19 Admission Batch)

3rd Semester

PSE301	Power System Transients	3-0-0	Credits 3

Course Objectives

Students will be able to

1. Learn the reasons for occurrence of transients in a powersystem
2. Understand the change in parameters like voltage & frequency duringtransients
3. Know about the lightning phenomenon and its effect on powersystem

Syllabus

MODULE-I **(10 Hours)**

Fundamental circuit analysis of electrical transients, Laplace Transform method of solving simple Switching transients, Damping circuits -Abnormal switching transients, Three-phase circuits andtransients, Computation of power system transients.

Principle of digital computation –Matrix method of solution, Modal analysis- Ztransform. Computation using EMTP. Lightning, switching and temporary overvoltages.

Lightning: Physical phenomena oflightning.

MODULE-II **(11 Hours)**

Interaction between lightning and powersystem, Influence of tower footing resistance and EarthResistance, Switching: Short line or kilometricfault, Energizing transients - closing and re-closing oflines, Line dropping, loadrejection, Over voltages induced byfaults.

MODULE-III **(11 Hours)**

Switching HVDC line Travelling waves on transmission line: Circuits with distributed Parameters, Wave Equation, Reflection, Refraction. Behaviour of Travelling waves at the line terminations, Lattice Diagrams – Attenuation and Distortion, Multi-conductor system and Velocity wave.

MODULE-IV **(10 Hours)**

Insulation co-ordination: Principle of insulation co-ordination in Air Insulated substation (AIS) and Gas Insulated Substation (GIS), Co-ordination between insulation and protection level, Statistical approach, Protective devices- Protection of system against overvoltages, Lightning arresters, Substation earthing

Suggested reading

1. Allan Greenwood, “Electrical Transients in Power System”, Wiley & Sons Inc. New York, 1991

Course Outcomes

Students will be ableto

1. Have knowledge of various transients that could occur in power system and their mathematical formulation
2. Have ability to design various protective devices in power system for protecting equipment and personnel
3. Coordinate the insulation of various equipments in power system
4. Model the power system for transient analysis

PEE302	FACTS and Custom Power Devices	3-0-0	Credits 3

Course Objectives:

Students will be able to:

1. To learn the active and reactive power flow control in power system
2. To understand the need for static compensators
3. To develop the different control strategies used for compensation

MODULE-I **(11 Hours)**

Reactive power flow control in Power Systems – Control of dynamic power unbalances in Power System, Power flow control -Constraints of maximum transmission line loading – Benefits of FACTS Transmission line compensation.

Uncompensated line -Shunt compensation - Series compensation–Phase angle control. Reactive power compensation. Shunt and Series compensation principles – Reactive compensation transmission and distribution level.

MODULE-II **(10 Hours)**

Static versus passive VAR compensator, Static shunt compensators: SVC and STATCOM - Operation and control of TSC, TCR and STATCOM – Compensator control.

Comparison between SVC and STATCOM. Static series compensation: TSSC, SSSC -Static voltage and phase angle regulators – TCVR and TCPAR Operation and Control –Applications, Static series compensation–GCSC, TSSC, TCSC and Static synchronous series compensators and their Control.

MODULE-III **(11 Hours)**

SSR and its damping Unified Power Flow Controller: Circuit Arrangement, Operation and control of UPF.

Basic Principle of P and Q control- Independent real and reactive power flow control-Applications.

MODULE-IV **(10 Hours)**

Introduction to interline power flow controller. Modeling and analysis of FACTS Controllers – Simulation of FACTS controllers Power quality problems in distribution systems, harmonics. Loads that create harmonics, modeling, harmonic propagation, series and parallel resonances, mitigation of harmonics, passive filters, active filtering– shunt, series and hybrid and their control. Voltage swells, sags, flicker, unbalance and mitigation of these problems by power line conditioners- IEEE standards on power quality.

Suggested reading

1. K.R. Padiyar, "FACTS Controllers in Power Transmission and Distribution", New Age International Publishers, 2007**.**
2. X P Zhang, C Rehtanz, B Pal, "Flexible AC Transmission Systems- Modelling and Control", Springer Verlag, Berlin, 2006.
3. N.G. Hingorani, L. Gyugyi, "Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems", IEEE Press Book, Standard Publishers and Distributors, Delhi, 2001.
4. K.S. Suresh kumar, S. Ashok, "FACTS Controllers & Applications", E-book edition, Nalanda Digital Library, NIT Calicut, 2003.
5. G. T. Heydt, "Power Quality", McGraw-Hill Professional, 2007.
6. T. J. E. Miller, "Static Reactive Power Compensation", John Wiley and Sons, Newyork, 1982.

Course Outcomes:

Students will be able to:

1. Acquire knowledge about the fundamental principles of Passive and Active Reactive Power Compensation Schemes at Transmission and Distribution level in Power Systems.
2. Learn various Static VAR Compensation Schemes like Thyristor /GTO Controlled.
3. Reactive Power Systems, PWM Inverter based Reactive Power Systems and their controls.
4. To develop analytical modeling skills needed for modeling and analysis of such Static VAR Systems.

PSE303	Industrial Load Modelling and Control	3-0-0	Credits 3

Course Objectives: -Students will be able to:

1. To understand the energy demandscenario
2. To understand the modeling of load and its ease to study load demandindustrially
3. To know Electricity pricingmodels
4. Study Reactive power management in Industries

MODULE-I **(11 Hours)**

Electric Energy Scenario-Demand Side Management-Industrial Load ManagementLoad Curves-Load ShapingObjectivesMethodologies-BarriersClassification ofIndustrial, Loads Continuous and Batch processes -LoadModeling

MODULE-II **(11 Hours)**

Electricity pricing – Dynamic and spot pricing–Model Direct load control- Interruptible loadcontrolBottom up approach- scheduling- Formulation of load Models

Optimization and control algorithms - Casestudies.

Reactive power management in industries Controls-power quality impacts.

Application of filters Energy saving in industries

MODULE-III **(10 Hours)**

Cooling and heating loads. Load profiling Modeling- Cool storage Types- Control strategies

Optimal operation Problem formulation- Case studies Captive power units

Operating and control strategies Power Pooling- Operation models Energy banking

Industrial Cogeneration

MODULE-IV **(10 Hours)**

Selection of Schemes Optimal Operating Strategies Peak load saving

Constraints Problem formulation- Casestudy Integrated Load management for Industries.

Suggested reading

1. C.O. Bjork " Industrial Load Management - Theory, Practice and Simulations", Elsevier, the Netherlands,1989
2. C.W. Gellings and S.N. Talukdar, Load management concepts. IEEE Press, New York, 1986, pp.3-28
3. Y. Manichaikul and F.C. Schweppe," Physically based Industrial load", IEEE Trans. on PAS, April1981
4. H. G. Stoll, "Least cost Electricity Utility Planning", Wiley Interscience Publication, USA,1989.
5. I.J. Nagarath and D.P. Kothari, .Modern Power System Engineering., Tata McGraw Hillpublishers, NewDelhi,1995
6. IEEE Bronze Book- "Recommended Practice for Energy Conservation and cost effective planning in Industrial facilities", IEEE Inc, USA

Course Outcomes: -

Students will be able to:

1. Have knowledge about load control techniques in industries and its application

2. Learn different types of industrial processes and optimize the process using tools like LINDO and LINGO
3. Apply load management to reduce demand of electricity during peak time
4. Apply different energy saving opportunities in industries

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

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BRANCH: ELECTRONICS AND TELECOMMUNICATION ENGINEERING (2018-19 Admission Batch)

First Semester

Theory

Course Code	Course Name	L-T-P (Periods/ Week)	Credits
	Programme Core-1	3-0-0	3
ECC101	Advanced Communication Techniques		
	Programme Core-2	3-0-0	3
ECC102	Adaptive Signal Processing		
	Programme Elective-1 (Any One) To be chosen from list of Electives	3-0-0	3
	Programme Elective-2 (Any One) To be chosen from list of Electives	3-0-0	3
GHM101	Research Methodology & Intellectual Property Rights	2-0-0	2
	Audit Course-1 (Any One from the list of Audit Courses)	2-0-0	0
	Total (Theory)	**16**	**14**

Practical/ Sessional

	Lab-1	0-0-4	2
ECC103	Advance Communication and Network Lab		
	Lab-2	0-0-4	2
ECC104	Design and Simulation Lab I		
	Total (Practical/ Sessional)	**8**	**4**
	TOTAL	**24**	**18**

TOTAL SEMESTER CREDITS: 18

TOTAL CUMULATIVE CREDITS: 18

Second Semester

Theory

Course Code	Course Name	L-T-P (Periods/ Week)	Credits
	Programme Core-3	3-0-0	3
ECC201	Information Theory and Coding		
	Programme Core-4	3-0-0	3
ECC202	Advanced Wireless Communication		
	Programme Elective-3 (Any One) To be chosen from list of Electives	3-0-0	3
	Programme Elective-4 (Any One) To be chosen from list of Electives	3-0-0	3
	Audit Course-2 (Any One from the list of Audit Courses)	2-0-0	0
	Total (Theory)	**14**	**12**

Practical/ Sessional

	Lab-3	0-0-4	2
ECC203	Wireless Sensor Networking Lab		
	Lab-4	0-0-4	2
ECC204	Design And Simulation Lab II		
ECJ201	**Mini Project with Seminar**	0-0-4	2
	Total (Practical/ Sessional)	**12**	**6**
	TOTAL	**26**	**18**

TOTAL SEMESTER CREDITS: 18

TOTAL CUMULATIVE CREDITS: 36

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Third Semester				Fourth Semester			
Theory				**Theory**			
Course Code	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**	**Course Code**	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**
	Programme Elective-5 (Any One) To be chosen from list of Electives	3-0-0	3				
	Open Elective (Any One) Business Analytics Industrial Safety Operations Research Cost Management of Engineering Projects Composite Materials Waste to Energy Internet of Things Soft Computing Project Engineering & Management Start-up & Entrepreneurship Development	3-0-0	3				
	Total (Theory)	**6**	**6**		**Total (Theory)**	**0**	**0**
	Practical/ Sessional				**Practical/ Sessional**		
ECJ301	Dissertation Phase-I	0-0-20	10	ECJ401	Dissertation Phase-II	0-0-32	16
	Total (Practical/ Sessional)	**20**	**10**		**Total (Practical/ Sessional)**	**32**	**16**
	TOTAL	**26**	**16**		**TOTAL**	**32**	**16**
TOTAL SEMESTER CREDITS: 16				TOTAL SEMESTER CREDITS: 16			
TOTAL CUMULATIVE CREDITS: 52				TOTAL CUMULATIVE CREDITS: 68			

List of Audit courses

1	AHM101	English for Research Paper Writing
2	ACE101	Disaster Management
3	AHM102	Sanskrit for Technical Knowledge
4	AHM103	Value Education
5	AHM104	Constitution of India
6	AHM105	Pedagogy Studies
7	AHM106	Stress Management by Yoga
8	AHM107	Personality Development through Life Enlightenment Skills

List of Programme Elective Subjects

SL. No.	Subject Code	Subject Name
1	ECE101	Optical Communication and Network
2	ECE102	Internet Of Things
3	ECE103	Pattern Recognition and Machine Learning
4	ECE104	Modern Radar System
5	ECE105	Computational Intelligence
6	ECE106	Telecommunication Switching and Network
7	ECE107	Data Security and Cryptography
8	ECE108	Fiber Optics Devices and Components
9	ECE109	Cognitive Radio System
10	ECE110	VLSI for Wireless Communication
11	ECE111	Satellite Communication System
12	ECE112	Wireless Sensor Network
13	ECE113	Security in Wireless and Mobile Communication
14	ECE114	Antenna Theory and Design
15	ECE115	Optical Wireless Communication
16	ECE116	Mathematics for Communication Engineers
17	ECE117	Multimedia Communication
18	ECE118	Embedded System Design
19	ECE119	MIMO Communication System
20	ECE120	Remote Sensing and Advanced Techniques

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ECC101	Advanced Communication Techniques	3-0-0	Credits 3

Course Objectives:

1. To understand the band pass modulation and demodulation.
2. To be aware with the concepts of multichannel and multicarrier systems & spread spectrum techniques.
3. To understand the error control coding perception and equalization techniques.
4. To be familiarize with advance ideas of Fading & Communication Link Analysis.

MODULE-I **(12 Hours)**

Digital Modulation Scheme

Mathematical models for communication channels & their characteristics**,** Representation of Digitally Modulated Signals, Memoryless Modulation Methods; Signalling schemes with memory; Linear modulation with memory, MSK , GMSK, Continuous-Phase Frequency-Shift Keying; Overview of AWGN Channel, Detection of Binary Signals in Gaussian Noise, Detection of Signals in Gaussian Noise.

Carrier and Symbol Synchronization

Signal Parameter estimation; Carrier phase estimation; Symbol timing estimation; Joint estimation.

MODULE-II **(12 Hours)**

Multichannel and Multicarrier Systems

Multichannel Digital Communications in AWGN Channels; Multicarrier Communications; Single Carrier verses Multicarrier Modulation, Introduction to OFDM, Modulation & Demodulation in an OFDM, Principle of multi path propagation, Impulse response model of channels, parameters for mobile multi path channels.

Spread Spectrum Techniques

Spread-Spectrum Overviews, Pseudonoise Sequences, Direct-Sequence, Spread-Spectrum Systems, Frequency Hopping Systems, Synchronization, Jamming Considerations, Commercial Applications, Cellular Systems.

MODULE-III **(8 Hours)**

Error Control Coding

Introduction & Basic definition to Linear Block Codes; equivalent codes, syndrome decoding, Hamming Codes, Optimal Linear codes; ConvolutionCodes: Representation of codes using polynomial, State diagram, Tree Codes and Trellis Codes, Viterbi algorithm.

EqualizationTechnique

Linear equalizer and nonlinear equalization, algorithms for adaptive equalization.

MODULE-IV **(10 Hours)**

Fading Channels

The Challenge of Communicating over Fading Channels, Characterizing, Mobile-Radio Propagation, Signal Time-Spreading, Time Variance of the Channel Caused by Motion Mitigating the Degradation Effects of Fading, Summary of the Key Parameters Characterizing Fading Channels, Applications: Mitigating the Effects of Frequency Selective Fading.

Communications Link Analysis

Channel and sources of signal loss, Received Signal Power and Noise Power, Link Budget Analysis, Noise Figure, Noise Temperature, and System Temperature, Sample Link Analysis, Satellite Repeaters.

Text Books:

1. J. G. Proakis and Masoud Salehi, "Digital Communications", Mc Graw Hill, 5th edition, 2008.
2. Bernard Sklar, "Digital Communications – Fundamentals and applications", Pearson education, 2nd edition, 2001.
3. T. S. Rappaport, "Wireless Communications", Pearson Education, 2nd Edition, 2007.

Reference Books:

1. Itisaha Mishra, "Wireless Communications & Network 3G and beyond", Tata Mc-Graw Hill, 2nd edition, 2013.
2. J. G. Proakis, M. Salehi, "Communication Systems Engineering", Pearson Education International, 2002.
3. Ranjan Bose, "Information Theory, Coding and Cryptography", Tata McGraw-Hill, 2nd edition, 2008.

Course Outcomes:

1. Select modulation and detection techniques for a given communication link.
2. Design optimal coding schemes for efficient use of channel capacity.
3. Understanding various formatting & modulation process.
4. Acquiring knowledge on the theory of communication link analysis.
5. Detailed perception of Spread Spectrum Techniques, Fading Channels, etc.

ECC102	Adaptive Signal Processing	3-0-0	Credits 3

Course Objectives:

1. Use of adaptive filtering algorithms and structures to learn the optimal filter or estimator and track time-varying system dynamics in order to improve the performance over static, fixed filtering techniques.
2. To implement adaptive systems with application to digital communications, beam forming, control systems, and interference cancellation.
3. To create an adaptive equalizer for digital communications over a time-varying channel.

MODULE-I **(10 Hours)**

ADAPTIVE SYSTEMS:

Characteristics, Areas of application, general properties, open and closed loop adaptation, applications of closed loop adaptation, Example of an Adaptive System, The Adaptive Linear Combiner: Description, Weight Vectors, Desired Response, Performance Function; Gradient and Minimum Mean-Square Error. Approaches to the Development of Adaptive Filter Theory: Introduction to Filtering Smoothing and Prediction-Linear Optimum Filtering, Problem Statement, Principle of Orthogonality, Minimum–Mean-Squared Error, Wiener–Hopf Equations, Error Performance, Normal Equation.

MODULE-II **(10 Hours)**

GRADIENT SEARCHING AND ESTIMATION:

Searching the Performance Surface – Methods and Ideas of Gradient Search Methods, Gradient Searching Algorithm and its Solution, Stability and Rate of Convergence, Learning Curves, Gradient Search by Newton's Method, Method of Steepest Descent, and Comparison of Learning Curves. Gradient component estimation by derivative measurement, the performance penalty, derivative measurement and performance penalties with multiple weights, variance of the gradient estimate, effects on the weight vector solution.

MODULE-III **(12 Hours)**

LMS & RLS ALGORITHMS:

Overview, LMS Adaptation Algorithms, Stability and Performance Analysis of LMS Algorithms, LMS Gradient and Stochastic Algorithms, Convergence of LMS Algorithms, RLS algorithms

ADAPTIVE MODELING AND SYSTEM IDENTIFICATION:

General description, adaptive modeling of multipath communication channel, adaptive modeling in geophysical exploration, adaptive modeling in FIR digital filter synthesis, general description of inverse modeling, some theoretical examples.

MODULE-IV **(10 Hours)**

KALMAN FILTERING THEORY:

Introduction, Recursive Mean Square Estimation for Scalar Random Variables, Statement of Kalman Filtering

Problem, Innovation Process. Estimation of State using the Innovation Process, Filtering, Initial Conditions, Summary of Kalman Filters, Variants of the Kalman Filtering, the Extend Kalman Filtering, Identification as a Kalman Filtering Problem.

Text Books:

1. Bernand Widrow and Samuel D. Stearns, "Adaptive Signal Processing", Pearson Education, 2009.
2. Simon Haykins, "Adaptive filter Theory", PHI, 2003.

Reference Books:

1. Sophocles J. Orfamidis, "Optimum Signal Processing – An Introduction", 2nd edition, McGraw Hill, 2005.
2. S. Thomas Alexander, "Adaptive Signal Processing – Theory and Applications", Springer Verlag, 1986.
3. Tulay Adali, Simon Haykin, "Adaptive Signal Processing – Next Generation Solutions", Wiley, 2012.

Course Outcomes:

1. Comprehend design criteria and modeling adaptive systems and theoretical performance evaluation.
2. Design a linear adaptive processor.
3. Able to apply mathematical models for error performance and stability.
4. Able to apply adaptive modeling systems for real time applications.
5. Comprehend the estimation theory for linear systems and modeling algorithms.

ECC201	Information Theory and Coding	3-0-0	Credits 3

Course Objectives:

1. Fundamental concept of entropy and information as they are used in communications.
2. To enhance knowledge about source coding and channel capacity of information.
3. To fundamental theories and laws of error control codes, cyclic codes and BCH codes.

MODULE-I **(11 Hours)**

Source Coding

Introduction to information theory, uncertainty of information, Information measure, entropy, source coding theorem, Huffman Coding, run length encoding, rate distortion function, JPEG and MPEG standards in image compression.

Channel Capacity and Coding

Channel models, Channel Capacity, Channel Coding, Information Capacity Theorem, Shannon Limit.

MODULE-II **(10 Hours)**

Error Control Coding

Linear Block Codes: Introduction, Basic definition, equivalent codes, parity check matrix, decoding, syndrome decoding, Perfect Codes, Hamming Codes, Optimal Linear codes.

Cyclic Codes

Introduction polynomials, The division Algorithm, Method for generating cyclic codes, Burst Error correction, Fire Codes, Golay Codes, CRC Codes, Circuit implementation.

MODULE-III **(11 Hours)**

Convolutional Codes

Introduction, Tree Codes and Trellis Codes, Polynomial description, The Generating function, Matrix Description, Viterbi Decoding, Distance bounds, Turbo Codes, Turbo Decoding.

MODULE-IV **(10 Hours)**

Trellis Coded Modulation (TCM)

Introduction, the concept of coded modulation, Mapping by set Partitioning, Design rules, TCM Decoder.

Text Books:

1. Ranjan Bose, "Information Theory, Coding and Cryptography", Tata McGraw-Hill, 2nd edition, 2008John M. Senior, "Optical Fiber Communications", Pearson, 3rd edition, 2010.
2. J. G. Proakis, "Digital Communications", McGraw-Hill Publication, 3rd edition, 1994.

Reference Books:

1. Shu lin and Daniel J .Costello, "Error Control Coding", Pearson Education India, 2011.
2. R. Avudaiammal, "Information Coding Techniques", Tat McGraw-Hill, 2nd edition, 2009.
3. Bernard Sklar, "Digital Communications - Fundamental and Applications", Pearson education Publication, 2nd edition, 2009.

Course Outcomes:

1. Evaluation of information content of a random variable from its probability distribution.
2. Knowledge about channel capacity using Shannon's Theorem.
3. Design of digital communication bycyclic, BCH, convolutional and TCM codes.

ECC202	Advanced Wireless Communication	3-0-0	Credits 3

Course Objectives:

1. Describe the type and appropriate model of wireless fading channel based on the system parameters and the property of the wireless medium.
2. Analyze and design receiver and transmitter diversity techniques.
3. Determine the appropriate transceiver design of multi-antenna systems and evaluate the data rate performance.
4. Distinguish the major cellular communication standards (1G/2G/3G systems).

MODULE-1 **(11 Hours)**

Introduction

Introduction to wireless communications, Introduction to various wireless channel models (frequency flat, frequency selective, Rayleigh and Ricean fading models) Diversity, Equalization and Cellular Communications.

MODULE-II **(10 Hours)**

Spread Spectrum Techniques

Introduction to CDMA and associated standards, Introduction to the notion of channel capacity, Capacity of scalar wireless channels, Capacity of time invariant channels, Capacity of time varying (or fading) channels.

Introduction to OFDM, OFDM mathematical representation, windowing in OFDM signal and spectral efficiency Synchronization in OFDM, Pilot Insertion in OFDM, Amplitude limitations in OFDM, CDMA vs OFDM, Hybrid OFDM and Variants of OFDM.

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MODULE-III **(11 Hours)**

MIMO Systems

MIMO: Space Diversity and systems based on space diversity, Smart antenna system and MIMO, MIMO exploits Multipath, Space-Time Processing, Antenna considerations for MIMO, MIMO channel modeling, measurement, and Capacity, Cyclic Delay Diversity (CDD), Space-Time coding, Advances and Applications of MIMO, MIMO-OFDM. Capacity of time varying (fading) channels, Capacity of vector (MISO, SIMO, MIMO) channels and spatial multiplexing.

MODULE-IV **(10 Hours)**

Wireless Broadcast Networks

Wireless Broadcast Networks: Digital Audio Broadcasting (DAB), Digital Radio Mondiale (DRM), HD Radio Technology, Digital Video Broadcasting (DVB), Direct to Home (DTH).

Wireless Cellular and Ad Hoc Networks: GSM System, GPRS, EDGE Technology, CDMA-based Digital Cellular Standards, WLL, IMT-2000, Mobile Satellite Communication, 3G, 4G and Beyond. Bluetooth, Wi-Fi

Standards, WiMAX standards, Wireless sensor networks, IEEE 802.15.4 and Zigbee, UWB, IEEE 802.20 and beyond

Text Books:

1. David Tse and Pramod Viswanath, "Fundamentals of wireless communications", Cambridge University Press, 1st edition, 2012.
2. Upena Dalal, "Wireless Communication", Oxford University Press, 2009.
3. E. Biglieri, "MIMO Wireless Communications", Cambridge University Press, 2007.

Reference Books:

1. T. S. Rappaport, "Wireless Communications: Principles and Practice", Prentice Hall of India, 2nd Edition, 2007.
2. A. Goldsmith, "Wireless Communications", Cambridge University Press, 2005.

Course Outcomes:

1. Understand Distinguish the trade-offs among frequency reuse, channel capacity, and spectral efficiency.
2. Illustration of path loss and shadowing effect.
3. Knowledge on various diversity techniques & simple equalization schemes.
4. Characterization of multiple access schemes.

ECE101	Optical Communication and Network	3-0-0	Credits 3

Course Objectives:

1. To be familiar with optical fiber communication.
2. To gain knowledge of different types of optical fiber and optical fiber components.
3. To have knowledge over ray optics and wave representation of light in fiber communication.
4. To have a detail understanding of fiber communication network.

MODULE-1 **(11 Hours)**

Overview of Optical Fiber Communication, Optical Fiber: Structure, Waveguiding, Fabrication

Introduction to optical communication: Evolution of Fiber Optic Systems, Basic optical laws and definition, Optical fiber modes and configuration, Ray optics representation, Wave representation, mode theory for circular wave guide, modes in step index fiber, linearly polarised modes, propagation modes in single mode fibers. Graded index fiber structure, graded-index numerical aperture (NA). Elementary ideas on fiber materials, fabrication and fiber optic cables.

MODULE-II **(10 Hours)**

Signal Degradation and Distortion in Optical Fiber, Optical Amplifier

Signal degradation in Optical fibers, Attenuation, Absorption, Scattering losses, bending losses, core and cladding losses. Signal distortion in optical wave guides. Information capacity of optical fibers. Material dispersion, wave guide dispersion, inter modal dispersion. Optical amplifier- EDFA, Raman amplifier.

MODULE-III **(11 Hours)**

Optical Sources, Photodetectors, Optical Receiver Operation, Digital Transmission System

Basic ideas of light sources and their principle of operation (LEDs and LASERs), power-bandwidth product of LEDs and resonant frequencies of LASER diodes. Physical principles of photo detectors, Avalanche photo diodes. Optical receiver operation (Fundamentals): Digital signal transmission, error sources, Digital transmission systems, link power budget, Rise time budget.

MODULE-IV **(10 Hours)**

Fiber Optic Networking

Introduction to Optical Networks (SONET, IP), Optical layer, Transparency and All-Optical Networks, Optical Packet Switching, Fibre Optic Network Topology & principles, LAN, MAN, FDDI networking. Multiplexing methods in fibre optic networks. Concepts of WDM and TDM.

Text Books:

1. Gerd Keiser, "Optical Fiber Communications", TMH, 4th edition, 2008.
2. John M. Senior, "Optical Fiber Communications", Pearson, 3rd edition, 2010.
3. R. Ramaswami, K. N. Sivarajan, G. H. Sasaki, "Optical Networks: A Practical Perspective", OSA, 3rd edition, 2009.

Reference Books:

1. Govind P. Agrawal, "Fiber Optic Communication Systems", John Wiley, 3rd edition, 2004.
2. Joseph C. Plais, "Fiber Optic Communication", Pearson Education, 4th edition, 2004.
3. G.K. Sarkar, D.C. Sarkar, "Opto Electronics and Fiber optic Communication", New Age International, 2nd edition, 2013.

Course Outcomes:

1. Understand the principles of fiber-optic communication and the bandwidth advantages.
2. Understand the properties of optical fibers and optical components.
3. Understand operation of lasers, LEDs, and detectors.
4. Analyze system performance of optical communication systems.
5. Design optical networks and understand non-linear effects in optical fibers.

ECE102	Internet Of Things	3-0-0	Credits 3

Course Objectives:

1. Vision and Introduction to IoT.
2. Vision and IoT Market perspective.
3. Data and Knowledge Management and use of Devices in IoT Technology.
4. Understand state of the Art-IoT Architecture.
5. Real World IoT Design Constraints, Industrial Automation and Commercial Building Automation IoT.

MODULE-I **(10 Hours)**

Introduction to Internet of Things

Introduction-Definition & Characteristics of IoT, Physical Design of IoT- Things in IoT, IoT Protocols, Logical Design of IoT- IoT Functional Blocks, IoT Communication Models, IoT Communication APIs, IoT Enabling Technologies- Wireless Sensor Networks, Cloud Computing, Big Data Analytics, Communication Protocols, Embedded Systems, IoT Levels & Deployment Templates.

MODULE-II **(09 Hours)**

Domain Specific IoTs

Home Automation: Smart Lighting, Smart Appliances, Intrusion Detection, Smoke/Gas Detectors, Cities-Smart Parking, Smart Lighting, Smart Roads, Environment-Weather Monitoring, Air Pollution Monitoring, Noise Pollution Monitoring, Forest Fire Detection, River Floods Detection, Energy- Smart Grids, Agriculture-Smart Irrigation.

IoT and M2M Introduction, M2M-Difference between IoT and M2M, SDN and NFV for IoT-Software Defined Networking, Network Function Virtualization

MODULE-III **(10 Hours)**

IoT Platforms Design Methodology

IoT Design Methodology-Purpose & Requirements Specification, Process Specification, Domain Model Specification, Information Model Specification, Service Specifications, IoT Level Specification, Functional View, specifications, operational view specification, Device & Component Integration, Application Development.

What is an IoT Device-Basic building blocks of an IoT Device, Exemplary Device: Raspberry Pi, About the Board, Linux on Raspberry Pi, Raspberry Pi Interfaces – Serial, SPI, I2C, Programming

Raspberry Pi with Python-Controlling LED with Raspberry Pi, interfacing an LED and Switch with Raspberry Pi, Interfacing a Light Sensor (LDR) with Raspberry Pi.

MODULE-IV **(13 Hours)**

IoT & Beyond

Use of Big Data and Visualization in IoT, Industry 4.0 Concepts.Overview of RFID, Overview of Android /

IOS App Development tools.

Text Books:

1. Arshdeep Bahga and Vijay Audisetti, "Internet of Things, A Hands on Approach", University Press, 1st edition, 2016.
2. Raj Kamal, "Internet of Things- Architecture and Design Principles", McGraw Hill, 1st edition, 2017.

Reference Books:

1. Adrian McEwen, "Designing the Internet of Things", Wiley, 1st edition, 2015.
2. Miller, "The Internet of Things: How Smart TVs, Smart Cars, Smart Homes and Smart Cities are Changing the World", Pearson, 1st edition, 2015.

Course Outcomes:

1. Understand the vision of IoT from global context.
2. Determine the market perspective of IoT.
3. Use of Devices, Gate ways and Data Management in IoT.
4. Building state of the art architecture in IoT.
5. Application of IoT in Industrial and Commercial Building Automation and Real world Design Constraints.

ECE103	Pattern Recognition and Machine Learning	3-0-0	Credits 3

Course Objective:

1. To provide an introduction to classical pattern recognition.
2. To provide links to the classical statistical pattern recognition techniques along with introductory concepts on neural network.
3. To understand applications of machine learning and neural network.

MODULE-I **(10 Hours)**

Probability Decision Theory

Risk Functions, Likelihood Functions, Decision Criteria, Decision Surfaces, Discriminant Functions, Gaussian Classifiers, Principal Component Analysis.

MODULE-II **(10 Hours)**

Receiver Operating Characteristics and DET Curves

Maximum Likelihood Estimation, Bias, Convergence ,Bayesian Parameter Estimation, Bayesian Learning, Principal Component Analysis, Advanced Discriminant Analysis.

MODULE-III **(12 Hours)**

Introduction to Hidden Markov Models (HMMs)

Parameter Estimation, Nonparametric Estimation Techniques, Support Vector Machines, Decision Trees Foundations of Machine Learning, Estimating, Comparing and Combining Classifiers, Clustering, Hierarchical Clustering, Discriminative Training, Statistical Significance.

MODULE-IV **(10 Hours)**

Introduction to Neural Networks

Regularization, Introduction to Deep Learning , training Deep Learning networks , Auto encoders and Convolutional Neural Networks, recurrent networks, Alternate Optimizers and Training Strategies, Applications: Sequential Decoding of Speech.

Text Books:

1. C.M. Bishop, "Pattern Recognition and Machine Learning", Springer, 1st edition, 2006.
2. R.O. Duda, P.E. Hart and D.G. Stork, "Pattern Classification", Wiley Inter science, 2001.

Reference Books:

1. D. J. C. MacKay, "Information Theory, Inference and Learning Algorithms", Cambridge University Press, 2004.

Course Outcomes:

1. Understand the theory, principles and algorithms used in machine learning to construct high performance information processing systems.
2. Familiarize with modern concepts for model selection and parameter estimation in recognition, decision making and statistical learning problems.
3. Knowledge on regression, classification, regularization, feature selection and density estimation in supervised mode of learning.

ECE104	Modern Radar System	3-0-0	Credits 3

Course Objectives:

1. Introduction to modern radar systems and signal processing techniques, for both civilian and defense applications.
2. Understand the design of radar signals.

3. Identify and explain engineering problems in relation to radar design.
4. Have an appreciation of future trends in radar, radar signal processing and new areas of application.

MODULE-I **(10 Hours)**

Introduction to Radar system and Signal Models

Review of selected signal processing concepts and operations, signal conditioning and interference suppression, detection and post processing. Signal models: Components of a radar signal, amplitude models, radar range equation and radar cross section.

MODULE-II **(12 Hours)**

Radar Waveform Design

The Matched filter, Matched filter for simple pulse, Range resolution of the Matched filter, Matched filtering for moving targets, The Ambiguity function: Definition and properties, Ambiguity function of a simple pulse, Range ambiguity, Doppler's ambiguity, Relation of slow time spectrum to ambiguity function.

MODULE-III **(10 Hours)**

Pulse Compression and Clutter

Basics of pulse compression, Time Bandwidth product, Linear frequency modulation, Clutter: Definition, Surface Clutter, Volume Clutter, Clutter spectrum, Clutter statistical models. Electronic Warfare: ESM, ECM, ECCM, IFM, types of jammers, calculation of Performance.

MODULE-IV **(10 Hours)**

Target Detection and Tracking

Basics of Target detection, Constant false Alarm Rate Detectors, Introduction to target tracking, Non-linear filtering, Data Association, Single target tracking, Multi target tracking.

Text Books:

1. M. A. Richards, "Fundamentals of radar signal processing", Tata McGraw-Hill, 2nd edition, 2005.
2. J. Scheer, and A. H. William, "Principles of modern radar*",* SciTech, 2010.

Reference Books:

1. M. Skolnik, "Introduction to Radar Systems", Tata McGraw Hill, 3rd edition, 2003.
2. H. Meikle, "Modern Radar Systems", Arctech House, 2nd edition, 2008.

Course Outcomes:

1. Understand the radar equation and its application.
2. Apply appropriate mathematical and computer models relevant to radar systems to calculate system

performance.

3. Understand the design of radar signals, and FM radar.
4. Analyze the performance of simple tracking radar systems.

ECE105	Computational Intelligence	3-0-0	Credits 3

Course Objective:

1. Knowledge of non-traditional technologies and fundamentals of artificial neural networks, fuzzy sets, fuzzy logic, Fuzzy Inference System and Genetic algorithms.
2. To provide ideas on fuzzification and defuzzification methods supported in fuzzy logic.
3. To understand the need for optimization and different techniques involved.

MODULE-I **(12 Hours)**

Introduction to Soft Computing

Soft computing constituents and conventional Artificial Intelligence, Neuro-Fuzzy and Soft Computing characteristics.

Fuzzy Sets, Fuzzy Rules and Fuzzy Reasoning

Introduction, Basic definitions and terminology, Set-theoretic operations, MF Formulation and parameterization, More on fuzzy union, intersection, and complement, Extension principle and fuzzy relations, Fuzzy If-Then rules, Fuzzy reasoning.

Fuzzy Inference System

Mamdani fuzzy models, Sugeno Fuzzy Models, Tsukamoto fuzzy models.

MODULE-II **(12 Hours)**

Derivative-based optimization

Descent methods, the method of steepest descent, Newton's methods, Step size determination, conjugate gradient methods, Analysis of quadratic case, nonlinear least-squares problems, Incorporation of stochastic mechanism.

Derivative-free optimization

Genetic algorithm simulated annealing, random search, Downhill simplex search, Swarm Intelligence, genetic programming.

Adaptive Networks

Architecture, Back propagation for feed forward networks, Extended back propagation for recurrent networks, Hybrid learning rule: combing steepest descent and LSE.

MODULE-III **(10 Hours)**

Supervised learning neural networks

Perceptions, Adaline, Back propagation multi layer perceptions, Radial Basic Function networks.

Unsupervised learning and other neural networks

Competitive learning networks, Kohonen self-organizing networks, learning vector quantization, Hebbian learning and the Hopfield network.

MODULE-IV **(8 Hours)**

Adaptive Neuro-fuzzy inference systems

ANFIS architecture, Hybrid learning algorithms, Learning methods that cross-fertilize ANFIS and RBNF, ANFIS as universal approximator, Simulation examples.

Text Books:

1. J. S. R. Jang, C. T. Sun and E. Mizutani, "Neuro-fuzzy and Soft Computing", PHI, 2005.
2. S. Rajasekaran, G. A. Vijaylakshmi Pai, "Neural Networks, Fuzzy Logic, and Genetic Algorithms", PHI, 2001.

Reference Books:

1. George J. Klir and Bo Yuan, "Fuzzy Sets and Fuzzy Logic: Theory and Applications", Prentice Hall, 1995.

Course Outcomes:

1. Apply fuzzy logic and reasoning to handle uncertainty and solve various engineering problems.
2. Apply genetic algorithms to combinatorial optimization problems.
3. Learn the application of algorithms for engineering Optimization.

ECE106	Telecommunication Switching and Network	3-0-0	Credits 3

Course Objectives:

1. To introduce fundamental functions of a telecommunication switching systems, Electronic space

division switching.

2. To introduce the concepts of space switching, time switching and combination switching.
3. To introduce a mathematical model for the analysis of telecommunication traffic.
4. To understand about various signaling in telecommunication systems.
5. To analyze various telecommunication networks.

MODULE-I **(10 Hours)**

Introduction

Evolution of Telecommunications, Simple Telephone Communication, Manual switching system, major telecommunication Networks, Strowger Switching System, Crossbar Switching.

Electronic space division switching

Stored Program Control, Centralized SPC, Distributed SPC, Enhanced Services, Two stage networks, Three stage network n-stage networks.

MODULE-II **(12 Hours)**

Time Division Switching

Basic time division space switching, time division time switching, time multiplexed space and time switching, combination switching, three-stage & n stage combination switching.

Traffic Engineering

Network traffic load and parameters, Grade of services & blocking probability, modeling of switching systems, incoming traffic & service time characterization, blocking models and loss estimates, Delay systems.

MODULE-III **(12 Hours)**

Telephone Networks

Subscriber Loop Systems, Switching Hierarchy and Routing, Transmission Plan, Transmission Systems, Numbering Plan, Charging Plan, Signaling Techniques, In channel signaling, common channel signaling, Cellular mobile telephony.

Data Networks

Data transmission in PSTN, switching techniques, Data communication architecture, ISO-OSI Reference Model, link-to-link layers, end-to-end layers, satellite based data networks, an overview of data network standards.

MODULE-IV **(08 Hours)**

Integrated Services Digital Networks

Motivation for ISDN, New services, Network and Protocol architecture, Transmission Channels, User Network Interface, signaling, Numbering and Addressing, Service characterization, Interworking , ISDN standards, Broadband ISDN, Voice data Integration.

Text Books:

1. Thiagarajan Viswanathan, "Telecommunication Switching Systems and Networks", PHI, 2nd edition, 2010.
2. J. E. Flood, "Telecommunications Switching, Traffic and Networks", Pearson Education, 1st edition, 2002.

Reference Books:

1. A. L. Garcia and I. Widiaja, "Communication Networks", TMH, 2004.
2. Bellamy John, "Digital Telephony", John Wily & Sons, 3rd edition. 2000.

Course Outcomes:

1. Analysis of various telecommunication networks.
2. Estimate the performance of Telecommunication Networks.
3. Calculation of Blocking probability in multistage networks.
4. Describe integrated networks.
5. To compare telephone network, data network and integrated service digital network.

ECE107	Data Security and Cryptography	3-0-0	Credits 3

Course Objectives:

1. To know and understand the fundamentals of Cryptography.
2. To acquire knowledge on standard algorithms used to provide confidentiality, integrity and authenticity.
3. To understand the various key distribution and management schemes.
4. To understand how to deploy encryption techniques to secure data in transit across data networks.

MODULE-I **(12 Hours)**

Understanding of the data security and Cryptography algorithms

Security Goals, Attacks, Services and Mechanism, Techniques, Traditional Symmetric-Key Ciphers, Substitution Ciphers, Transposition Ciphers, Stream and Block Ciphers, Modern Symmetric-Key Ciphers, Modern Block Ciphers, Modern Stream Ciphers, Data Encryption Standard (DES), DES Structure, DES Analysis, Multiple DES, Security of DES, Differential Cryptanalysis, Linear Cryptanalysis of DES.

MODULE-II **(10 Hours)**

Advanced data security and authentication of message

Advanced Encryption Standard (AES), Transformations, Key Expansion, Analysis of AES, Message Integrity and Message Authentication, Message integrity, Random Oracle Model, Message authentication, Cryptographic Hash Functions, SHA-512, Whirlpool.

MODULE-III **(8 Hours)**

Entity authentication mechanism and key management

Entity Authentication, Passwords, Challenge response, Zero knowledge, Key Management, Symmetric-key Distribution, Kerberos, Symmetric key agreement, Public key distribution.

MODULE-IV **(12 Hours)**

Application layer and Network layer security with case study using VHDL

Security at application layer, E-mail, PGP, S/MIME, Security at the network layer, Two modes, two security protocols, security association, security policy, Internet key exchange, Case Study Using VHDL, Introduction to VHDL, Syntax and commands in VHDL, Design of Cryptography model to achieve data security.

Text Books:

1. Behrouz A. Forouzan, "Cryptography and Network Security", McGraw-Hill, 2007.
2. Douglas L. Perry, "VHDL Programming by Example", McGraw-Hill, 4th edition, 2002.

Reference Books:

1. Atul Kahate, "Cryptography & Network Security", McGraw-Hill, 2nd edition, 2007.

Course Outcomes:

1. Analyze the vulnerabilities in any computing system and hence be able to design a security solution.
2. Identify the security issues in the network and resolve it.
3. Evaluate security mechanisms using rigorous theoretical approaches.
4. Design and implement the Cryptography model using VHDL.

ECE108	Fiber Optics Devices and Components	3-0-0	Credits 3

Course Objectives:

1. To expose the students to the basics of signal propagation through optical fibers, fiber impairments,

components and devices and system design.

2. Recognize and classify the structures of Optical fiber and types.
3. Classify the Optical sources and detectors and to discuss their principle.

MODULE-I **(10 Hours)**

Optical Fibers: Structures and Fabrication

Basic optical laws, Optical fiber modes and configurations, Mode theory of optical waveguides, single mode fibers, Graded indexed fibers, Fiber materials, Fiber fabrication, Mechanical properties of fiber, fiber optics cables, grating theory, application of diffraction grating, electro-optic effect.

MODULE-II **(10 Hours)**

Opto-Electronic Devices

Photo diode, PIN, photo-conductors, solar cells, phototransistors, materials used to fabricate LEDs and lasers design of LED for optical communication, response times of LEDs, Laser diodes, lasers classifications, lasers applications.

MODULE-III **(10 Hours)**

Optical Fiber Sensors

Active and passive optical fiber sensor, intensity modulated sensor, displacement type sensors, multimode active optical fiber sensor (micro bend sensor) single mode fiber sensor-phase modulates and polarization sensors.

MODULE-IV **(12 Hours**

Optical Amplifiers and Optical Components

Introduction to optical amplifiers, Semiconductor optical amplifiers, Erbium-doped fiber amplifiers, amplifier noise, optical SNR, wideband optical amplifiers, Overview of WDM, passive optical couplers, Isolators and circulators, fiber grating filters, Diffraction gratings, Active optical components.

Text Book:

1. G. Keiser, "Optical Fiber Communications", Tata McGraw Hill publications, 5th edition, 2014.
2. J. Wilson and J. B. Hawkes, "Opto-Electronics: An Introduction", Prentice Hall of India, 3rd edition, 2011.

Reference Book:

1. J. M. Senior, "Optical Fiber Communication-Principles and Practice", Prentice Hall of India, 1st edition, 1985.
2. G. P. Agrawal, "Fiber Optic Communication Systems", Wiley, 3rd edition, 2002.

Course Outcomes:

1. Recall basic laws of optical physics. Distinguish between the various modes of operation of optical fibers. Identify the various causes for signal degradation.
2. Understand the concept and working of different optoelectronic devices.
3. Provide adequate knowledge about the Industrial applications of optical fibers.
4. Discuss the channel impairments like losses and dispersion.

ECE109	Cognitive Radio System	3-0-0	Credits 3

Course Objectives:

1. To know the basics of Software Defined Radios and explore the principle of Cognitive Radio.
2. To learn the design of the wireless networks based on the cognitive radios.
3. To understand the concepts of wireless networks and next generation networks.
4. To discuss research challenges in Cognitive Radio Techniques.

MODULE-I **(12 Hours)**

Introduction to Software Defined Radio

The need for Software Radios& Definitions, Characteristics and Benefits of a Software Radio, Software Radio Architecture Evolution, Design Principles, Technology Tradeoffs and Architecture Implications.

SDR Architectur

Essential functions of software radio, Basics of SDR, Hardware Architecture, Computational Processing resources, Software Architecture, Top level component interfaces, Interface topologies among plug and play modules, SDR implementation issues.

MODULE-II **(12 Hours)**

SDR as Platform for Cognitive Radio

Introduction, Hardware and Software architecture, SDR development process and design, Application Software- Component Development.

Introduction to Cognitive Radios

SDR and application to cognitive radio networking, Overview of Cognitive Radio**,** Marking Radio self-aware, Cognitive Techniques**,** Position &Environment Awareness in Cognitive Radios, Optimization of Radio Resources.

MODULE-III **(10 Hours)**

Cognitive Radio Technology

Introduction, Radio flexibility and capability, Adaptability, Comparison of Radio compatibilities and

properties, Available Technologies, IEEE 802 Cognitive Radio related activities, Applications.

Cognitive Radio Architecture

Cognitive Radio, Functions, Components and design rules, Cognitive cycle- Orient, Plan, Decide and act phases, Inference Hierarchy, Architecture maps, Building the Cognitive Radio Architecture on Software Defined Architecture.

MODULE-IV **(8 Hours)**

Next Generation Wireless Networks

The XG Network Architecture, Spectrum Sensing, Spectrum Management, Spectrum Mobility, Spectrum Sharing, Upper layer issues, Cross-layer Design.

Technical Challenges

Design challenges associated with Cognitive Radio, Hardware requirements, Hidden primary user problem, detecting spread spectrum primary users, Sensing duration and frequency, Security issues.

Text Books:

1. Jeffrey H. Reed, "Software Radio: A modern approach to Radio Engineering", Prentice Hall PTR, 2002.
2. Joseph Mitola, "Software Radio Architecture: Object Oriented Approaches to wireless System Engineering", Wiley-Interscience, 1st edition, 2000.

Reference Books:

1. Bruce A Fette, "Cognitive Radio Technology", Academic Press, 2009.
2. Huseyin Arslan, "Cognitive Radio, Software Defined radio and Adaptive Wireless system", Springer, 1st edition, 2007.
3. M. Dillinger, K. Madani, N. Alonistioti, "Software Defined Radio: Architectures, Systems and Functions", John Wiley & Sons, 2005.

Course Outcomes:

1. Describe the basics of the Software defined Radios.
2. Design the wireless Networks Based on the Cognitive Radios.
3. Explain the Concepts behind the wireless Networks and Next generation Networks.
4. Design and operate Software Defined Radio systems.

ECE110	VLSI for Wireless Communication	3-0-0	Credits 3

Course Objectives:

1. To study the different electronics circuits such as mixer, filter and amplifier circuits used in the

transmission and reception of signal through Wireless medium.

2. To learn about the channels used for the Wireless Communication.
3. To analyze the synthesizer circuits used in the Wireless Communication Systems.

MODULE-I **(10 Hours)**

Overview of wireless communication and architecture

Communication Concepts in terms circuit designer perspective, Classical Channel, Path loss, Multipath fading (channel model), Receiver Architectures, Receiver front end, Filter design, Noise and Noise sources.

MODULE-II **(10 Hours)**

Study and Design of LNA and mixer circuits

Low Noise Amplifier, Wideband LNA design, Narrowband LNA (Impedance matching and Core Amplifier), Active Mixer, balancing, Qualitative description of Gilbert Mixer, Conversion Gain, Distortion (Low frequency and high frequency case).

MODULE-III **(10 Hours)**

Study and Design of Passive Mixer

Passive Mixer, Switching Mixer, Distortion, Conversion Gain and Noise in Unbalanced Switching Mixer, A practical Unbalanced Switching Mixer, Sampling Mixer, Conversion Gain, Distortion.

MODULE-IV **(12 Hours)**

Analysis of Synthesizer circuits

Frequency Synthesizer, Processing Components, PLL based Frequency Synthesizer, Phase Detector, Dividers, VCO, LCO, Phase noise Frequency Synthesizer, Loop Filter and System Design Introduction, Loop Filter (General description and design approaches).

Text Books:

1. Bosco Leung, "VLSI for Wireless Communication", Prentice Hall Electronics and VLSI series, 2002.
2. B. Razavi, "RF Microelectronics", Prentice Hall, 1998.

Reference Books:

1. Behzad Razavi, "Design of Analog CMOS Integrated Circuits", McGraw-Hill, 1999.
2. Thomas H.Lee, "The Design of CMOS Radio –Frequency Integrated Circuits", Cambridge University Press, 2003.

Course Outcomes:

1. Design and simulate the different Electronics circuits required for the Wireless Communication

System.

2. Analyze the noise associated with the transmission and reception of the signal through Wireless channel.

ECE111	Satellite Communication System	3-0-0	Credits 3

Course Objectives:

1. To understand the basic concept in the field of Satellite Communication and to place a satellite in an orbit.
2. To calculate the link power budget.
3. To get a complete knowledge about the earth and space subsystems.
4. To gain knowledge about the Satellite Access schemes.
5. To gain knowledge about the Satellite system and mobile services provided.

MODULE-I **(13 Hours)**

Introduction to satellite communication

Communication satellites; orbits and description, orbital period and velocity, azimuth and orbital inclination, coverage angle and slant range, eclipse, placement of satellite in geostationary orbit. Communication Engineering Satellite Description: Communication subsystem, Telemetry, command and ranging subsystem, altitude control subsystem, electrical power subsystem. Earth station: earth station antenna type, gain, pointing loss. Antenna gain to noise temperature variation G/T. G/T measurements. Spurious effect of frequency conversion. Satellite transponder: Transponder model, transponder channelization, frequency plans and processing transponders

MODULE-II **(12 Hours)**

Satellite link

Basic link analysis, interference analysis, Rain induced attenuation, satellite link design, link with frequency reuse and link without frequency reuse, satellite multiple access system. Frequency Division Multiple Access: Principle, SPADE, FDM-FM-FDMA, Companded FDM-FMFDMA and SSB-AM-FDMA, Intermodulation products in FDMA, optimized carrier-to-intermodulation plus noise ration.

MODULE-III **(09 Hours)**

Time Division Multiple Access

Principle, TDMA frame structure, TDMA burst structure, TDMA super frame structure, frame acquisition and synchronization. Satellite position determination, TDMA timing. Demand Assignment Multiple Access and digital speech interpolation. Erlang B formula. Type of demand assignment, DAMA characteristics, real time frame reconfiguration, DAMA interfaces, SCPC- DAMA, digital speech interpolation. Satellite packet communication.

MODULE-IV **(08 Hours)**

Very Small Aperture Terminal Network (VSAT)

VSAT technologies, Network configurations, Multi access and networking, Network error control polling VSAT network, Mobile Satellite Network (MSAT)-Operating environment, MSAT network concept, CDMA MSAT relink.

Text Books:

1. T. Pratt and C. W. Bostier,"Satellite Communication", John Wiley & Sons, 2nd edition, 2006.
2. D.C. Agrawal and A. K. Malini, "Satellite Communication", Khanna, 1991.

Reference Books:

1. Wilbur L.Pritchard, Hendri G. Suyderhoud, Robert A. Nelson, "Satellite Communication Systems Engineering", Prentice Hall, 2007.
2. N. Agarwal, "Design of Geosynchronous Space Craft", Prentice Hall, 1986.
3. Bruce R. Elbert, "The Satellite Communication Applications", Hand Book, Artech House, 1997.
4. Tri T. Ha, "Digital Satellite Communication", Mcgraw Higher Education, 2nd edition, 1990.

Course Outcomes:

1. Understand orbital mechanics and launching methodologies.
2. Understand satellite subsystems and link power budget for satellites.
3. Compare competitive satellite services and understand satellite access techniques.

ECE112	Wireless Sensor Network	3-0-0	Credits 3

Course Objectives:

1. To apply knowledge of wireless sensor networks (WSN) to various application areas.
2. To design and implement WSN.
3. To formulate and solve problems creatively in the areas of WSN and IoT.

MODULE-I **(10 Hours)**

Introduction to Wireless Sensor Networks

WSN Architecture and Protocol Stack, Applications of WSN, Factors Influencing WSN Design: Hardware Constraints, Fault Tolerance, Scalability, Production Costs, WSN Topology, Transmission Media, Power Consumption, Wireless channel effects.

MODULE-II **(12 Hours)**

Medium Access Control

Challenges for MAC, CSMA Mechanism, Contention-Based Medium Access: S-MAC, B-MAC, CC-MAC, Reservation-Based Medium Access.

Error control

Classification of Error Control Schemes, Error Control in WSNs, Cross-layer Analysis Model, Comparison of Error Control Schemes: Hop Length Extension and Transmit Power Control.

MODULE-III **(10 Hours)**

Sensor Localization and Tracking

Canonical problem of Localization and tracking: A tracking scenario, problem formulation, Bayesian state estimation, Tracking multiple objects: state space decomposition, Data association, sensor models, Performance Comparison and Metrics.

MODULE-IV **(10 Hours)**

Sensor tasking and Control

Task-Driven Sensing, Information-Based Sensor Tasking, Joint Routing and Information Aggregation, Sensor network data base: Sensor Database Challenges, Querying the Physical Environment, Query Interfaces, High-Level Database Organization, In-Network Aggregation, Data-Centric Storage.

Text Book:

1. I. F. Akyildiz and M. C. Vuran, “Wireless Sensor Networks”, John Wiley and Sons, 2010.
2. Feng Zhao & Leonidas J. Guibas, “Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007.

Reference Book:

1. Bhaskar Krishnamachari, “Networking Wireless Sensors”, Cambridge Press, 2005.
2. Mohammad Ilyas and Imad Mahgaob, “Handbook of Sensor Networks: Compact Wireless and Wired Sensing Systems”, CRC Press, 2005.

Course Outcomes:

1. Understand the fundamentals and basic features of wireless sensor networking.
2. Able to identify, formulate, and solve engineering problems of wireless sensor networks.
3. To use the techniques, skills, and modern engineering tools necessary for engineering practice.

ECE113	Security in Wireless and Mobile Communication	3-0-0	Credits 3

Course Objectives:

1. Overview of mobile architecture and security.
2. Familiarize with the concept of Wireless Network Security.
3. Comprehensive knowledge on Ad hoc Network Security.
4. To learn and understand RFID Security.

MODULE-I **(10 Hours)**

Mobile Security

Mobile system architectures, Overview of mobile cellular systems, GSM and UMTS Security & Attacks, Vulnerabilities in Cellular Services, Cellular Jamming Attacks & Mitigation, Security in Cellular VoIP Services, Mobile application security.

MODULE-II **(10 Hours)**

Wireless Network Security

Overview of Wireless security, Scanning and Enumerating 802.11 Networks, Attacking 802.11 Networks, Attacking WPA protected 802.11 Networks, Bluetooth Scanning and Reconnaissance, Bluetooth Eavesdropping, Attacking and Exploiting Bluetooth, Zigbee Attacks, Zigbee Security.

MODULE-III **(10 Hours)**

Adhoc Network Security

Security in Ad Hoc Wireless Networks, Network Security Requirements, Issues and Challenges in Security Provisioning, Network Security Attacks, Key Management in Adhoc Wireless Networks, Secure Routing in Adhoc Wireless Networks.

MODULE-IV **(12 Hours)**

RFID Security

Introduction, RFID Security and privacy, RFID chips Techniques and Protocols, Man-in-the-middle attacks on RFID systems, Combining Physics and Cryptography to Enhance Privacy in RFID Systems, An Efficient and Secure RFID Security Method with Ownership Transfer, Policy-based Dynamic Privacy Protection Framework leveraging Globally Mobile RFIDs, User-Centric Security for RFID based Distributed Systems.

Text Books:

1. S. Kami Makki, Peter Reiher, Kia Makki, "Mobile and Wireless Network Security and Privacy", Springer, 2007.

2. C. Siva Ram Murthy, B. S. Manoj, "Ad Hoc Wireless Networks Architectures and Protocols", Prentice Hall, 2007.
3. Paris Kitsos, Yan Zhang, "RFID Security Techniques, Protocols and System-On-Chip Design", Springer, 2008.

Reference Book:

1. Noureddine Boudriga, "Security of Mobile Communications", Auerbach Publications, 2010.

Course Outcomes:

1. Understanding mobile architecture and security.
2. Acquiring ideas on wireless Network Security
3. Gaining knowledge on Ad hoc Network Security.
4. In depth understanding the concept of RFID Security.

ECE114	Antenna Theory and Design	3-0-0	Credits 3

Course Objectives:

1. To understand the fundamentals and different characteristics of antenna.
2. To provide comprehensive knowledge about different antennas.
3. To learn and understand antenna array design and feeding techniques.
4. Familiarize with the concept of antenna synthesis and different computational electromagnetic methods for antenna design.

MODULE-I **(7 Hours)**

Antenna fundamentals and definitions

Radiation mechanism- overview, EM fundamentals, Solution of Maxwell's equations for radiation problems, Ideal dipole, Radiation patterns, Directivity and gain, Antenna impedance, Radiation efficiency, Antenna polarization.

MODULE-II **(10 Hours)**

Resonant Antennas

Wired and patch antenna, Dipole antenna, Yagi-Uda antenna, Microstrip antenna.

Arrays

Array factor for linear arrays, Uniformly excited equally spaced linear arrays, Pattern multiplication, Directivity of linear arrays, Non-uniformly excited equally spaced linear arrays, Mutual coupling,

Multidimensional arrays, Phased arrays, Feeding techniques, Perspectives on Arrays.

MODULE-III **(11 Hours)**

Broadband antennas

Travelling wave antennas, Helical antennas, Bi-conical antennas, Principles of frequency independent antennas, Spiral antennas, and Log – periodic antennas.

Reflector antennas

Parabolic reflector antenna principles, Axi-symmetric parabolic reflector antenna, Offset parabolic reflectors, Dual reflector antennas, Gain calculations for reflector antennas, Feed antennas for reflectors, Matching the feed to the reflector, General feed model, Feed antennas used in practice.

MODULE-IV **(14 Hours)**

Antenna Synthesis

Formulation of the synthesis problem, Synthesis principles, Line sources shaped beam synthesis, Linear array shaped beam synthesis, Fourier series, Woodward - Lawson sampling method, Comparison of shaped beam synthesis methods, low side lobe narrow main beam synthesis methods, Dolph-Chebyshev linear array, Taylor line source method.

Method of moments

Introduction to the method of moments, Pocklington's integral equation, Integral equation and Kirchhoff's networking equations, Source modeling weighted residual formulations and computational consideration, Calculation of antenna and scatter characteristics.

Text Books:

1. C. A. Balanis, "Antenna Theory Analysis and Design", John Wiley, 4th edition, 2016.
2. Warren L.Stutzman, Gary A.Thiele, "Antenna theory and design", John Wiley and sons, 3rd edition, 2012.
3. J. D. Kraus, "Antennas", McGraw Hill TMH, 3rd edition, 2001.

Reference Book:

1. A. R Harish, M. Sachidnanda, "Antennas and wave propagation", Oxford University Press, 2007.

Course Outcomes:

1. Understanding different fundamental parameters of antenna.
2. Developing the basic skills necessary for designing a wide variety of practical antennas and antenna arrays.
3. Acquiring computational knowledge of antenna synthesis and method of moments.

ECE115	Optical Wireless Communication	3-0-0	Credits 3

Course Objectives:

1. Vision and Introduction to wireless optical communication system.
2. Learn the difference between FSO and radio frequency communication system.
3. Learn different applications of FSO.
4. Understand different types of atmospheric losses, and atmospheric turbulences in FSO.
5. Learn FSO channel modelling.
6. Learn Performance improvement of FSO using different diversity and channel coding techniques.

MODULE-I **(08 Hours)**

Overview of wireless optical communication system

Wireless optical communication system: An Overview, Indoor wireless optical communication system, Types of link configurations, Comparison of FSO and radio frequency communication system, Choice of wavelength in FSO communication system, Technologies used in FSO,

Coherent detection, Optical orthogonal frequency division multiplexing, Applications of FSO communication system.

MODULE-II **(12 Hours)**

Free space optical channel models

Atmospheric channel, Atmospheric losses, Atmospheric turbulence, Atmospheric turbulent channel model, Techniques for turbulence mitigation.

FSO system modules and design issues

Optical transmitters, Optical receivers, Optical modulators, Optical post and preamplifiers and Link design trade-off.

MODULE-III **(10 Hours)**

BER performance of FSO system

System model, BER Evaluation, Coherent subcarrier modulation schemes, Non-coherent modulation schemes (On-Off keying, M-ary Pulse position modulation, Differential PPM, Differential amplitude pulse position modulation).

MODULE-IV **(12 Hours)**

Link performance Improvement Techniques

Aperture averaging, Aperture averaging factor, Aperture averaging experiment, Types of Diversity Techniques, Diversity combining techniques, BER performance with Diversity technique, Coding, Channel

Capacity Channel coding in FSO system, Relay assisted FSO transmission.

Text Books:

1. Hemani Kaushal, V.K Jain, Subrat Kar, "Free Space Optical Communication", Springer, 2017.
2. Devi Chadha, "Terrestrial Wireless Optical Communication", Mc-Graw Hill Education, 2013.

Reference Books:

1. Olivier Bouchet, "Wireless Optical Communication", Wiley, 2013.
2. Z. Ghassemlooy, W. Popoola, S. Rajbhandari "Optical Wireless Communications: System & Channel Modelling with MATLAB", CRC Press, Taylor and Francis Group, 2017.

Course Outcomes:

1. Understand wireless optical communication system.
2. Determine the advantages and market perspective of FSO.
3. Use of transmitters, modulators, receivers and amplifiers in FSO.
4. Use of different diversity techniques to improve the BER performance of FSO communication system
5. Industrial applications of FSO communication system.

ECE116	Mathematics for Communication Engineers	3-0-0	Credits 3

Course Objectives:

1. To understand the basics and applications of linear algebra towards communication and signal processing.
2. Knowledge of principles of random variables and processes.
3. To understand various aspects of wireless communication systems using the concepts of probability and random variables as well as random processes.
4. To understand several components of wireless systems such as the average transmit power, bit-error rate and behavior of the fading channel coefficients.

MODULE-I **(12 Hours)**

Vector Spaces and Linear Algebra

Vector spaces: Liner combination of vectors, Linear independence, Basis and dimension, Norms and normed vector spaces, Inner product and Inner product spaces, Weighted inner products, Induced norms, Direction of Vectors: Orthoganality, orthogonal subspaces, Linear transformations: Range and Null spaces, projections and orthogonal projections, Projection theorem.

MODULE-II **(10 Hours)**

Linear operators and Matrices

Linear operators, Operator norms, Geometry of linear equations, properties of matrix inversion, Pseudo inverses, Eigen values and Eigen vectors: Linear dependence of Eigen vectors, computation of Eigen values and Eigen vectors, Diagonalization of a matrix, Signal subspace techniques: the signal model, the noise model.

MODULE-III **(10 Hours)**

Matrix Factorization

The LU factorization: Computing the determinant using the LU factorization, Computing the LU factorization, The Cholesky factorization, Unitary matrices and the QR factorization: Unitary matrices, The Singular Value Decomposition.

MODULE-IV **(10 Hours)**

Probability Theory and Random Process for Communication

Basics of probability, Conditional probability, Total probability, Random Variables, Probability density functions, Basics of Random Process, Wireless channel fading modeling, Gaussian random process, Calculation of Probability of error.

Text book:

1. T. K. Moon and W.C. Stirling, "Mathematical Methods and Algorithms for Signal Processing", Pearson Education, 2000.
2. A. Papoulis and S. U. Pillai, "Probability random variables and stochastic process, TMH, 4th edition, 2001.

Reference Book:

1. G. Strang, "Linear Algebra and its Applications", Cengage Learning, 3rd edition, 2014.
2. P. Z. Peebles, "Probability, Random Variables and Random Signal principles", Tata McGraw-Hill, 4th edition, 2002.

Course Objective:

1. Understand the formulation of problems in abstract algebra framework and vector analysis of signals.
2. Understand and represent linear transformations.
3. Understand the role of matrices in linear transformation representations.

ECE117	Multimedia Communication	3-0-0	Credits 3

Course Objectives:

1. Understanding the basic need of multimedia and component of multimedia.
2. To understand encoding and decoding of digital data streams.
3. To introduce methods for the generation of these codes and their decoding techniques.
4. To have a detailed knowledge of compression and decompression techniques.

MODULE-I **(09 Hours)**

Multimedia Information Representation

Text, Unformatted text, Formatted text, Hypertext, Images, Graphics, Digitized documents, Digitized pictures, Audio, PCM speech, CD quality audio, Synthesized audio, Video, Broadcast television, Digital video, Video content.

MODULE-II **(12 Hours)**

Multimedia Communications

Human Communication Model, PhysicalSystem, Symbol Encoding, Feeling, Memory, Cognitive System, Evolution and convergence, Technology Framework, Multimedia, Technologies, Multimedia Networking, Multimedia Conferencing, Multicasting, Technologies for e-Content. Standardization Framework, Research and Regulation, Technology and Education, Convergence and Regulatory Issues, Manufacturing and Marketing.

MODULE-III **(09 Hours)**

Frameworks for Multimedia Standardization

Standardization Activities**,** Standards to Build a New Global Information Infrastructure (GII), Standardization Processes on Multimedia Communications, ITU-T Mediacom 2004 Framework for Multimedia Communications, ISO/IEC MPEG-21 Multimedia Framework IETF Multimedia Internet Standards.

MODULE-IV **(12 Hours)**

Applications Layer – MPEG, JPEG

MPEG Applications, JPEG Application, Digital TV and Storage Media, Multimedia Conferencing, Streaming Media, and Interactive Broadcasting, Media Description, Searching and Retrieval, Media Distribution and Consumption. Media Streaming, MPEG-4 Delivery Framework, Streaming Video over the Internet, Broadband Access, Quality of Service, Framework.

Text Books:

1. K. R. Rao, Zoran S. Bojkovic and Dragorad A. Milovanovic, "Introduction to Multimedia Communications: Applications, Middleware, Networking", Wiley Interscience, 1st edition, 2006.
2. Fred Halsall, "Multimedia Communications: Applications, Networks, Protocols and Standards," Pearson education, 4th edition, 2009.

Reference Books:

1. Chen Chang Wen, Li, Zhu, Lian, Shiguo, "Intelligent Multimedia Communication: Techniques and Applications", Springer-Verlag, 2010.
2. John William Woods, "Multidimensional Signal, Image and Video Processing and Coding", Academic Press, 2nd edition, 2012.
3. R. Steimnetz, K. Nahrstedt, "Multimedia Computing, Communications and Applications", Pearson Education, 2004.
4. Ranjan Parekh, "Principles of Multimedia", TMH, 2007.

Course Outcomes:

1. To understand the multimedia communication and to know how communication and computing technologies bring new user interface.
2. To understand the various multimedia standards and their applications.
2. 3. Apply the compression concepts in multimedia communication.

ECE118	Embedded System Design	3-0-0	Credits 3

Course Objectives:

1. Understand the basics of embedded system development tools Atmel RISC Processors.
2. Write C programs for Microcontrollers.
3. Familiarize with the concepts of IDE and AVR families.
4. Fundamentals of Ardunio Uno and application.

MODULE-I **(10 Hours)**

ATMEL RISC Processors and Development Tools

Introduction, Basics of developing for embedded systems, embedded system Initialization Atmel RISC Processors Architecture, Memory, Reset and interrupt functions Parallel I/O ports, Timer/Counters, Serial communication using UART, SPI, Analog Interfaces, AVR RISC Assembly language instruction set.

MODULE-II **(10 Hours)**

Elements of C Programming and Preprocessor Functions

Variables and constants, I/O operations, Operators andExpressions, Control statements, Functions, Pointers and Arrays, Structure and Unions, Memory types, Real time methods, Standard I/O and Preprocessor functions.

MODULE-III **(10 Hours)**

IDE and Project Development

Code Vision AVR C Compiler and IDE: IDE**,** Operation, C Compiler Options, Compile and Make Projects, Program the target device, AVR code generator, Atmel AVR Studio debugger, Project development: Process steps.

MODULE-IV **(10 Hours)**

Introduction to Ardunio Uno

Introduction to Ardunio Platform, Block Digram, Architecture, Pin Configuration, Introduction to Arduino IDE, Writing, Saving, Compiling and Uploading Sketches, Interfacing discrete LEDs, Binary Counter, Seven Segment LEDs, Interfacing with Different type of Sensors and Communication modules.

Text Books

1. Qing Li with Caroline Yao, "Real-Time Concepts for Embedded Systems", CMP, 2011.
2. Barnett, Cox, and O'Cull "Embedded C Programming and the Atmel AVR" Thomson Delmar learning, 2006.
3. Simon Monk, "Programming Arduino", Mc Graw Hill Eduction, 2nd edition, 2012.

Reference Books

1. Jeremy Blum, "Exploring Arduino", Willy, 1st edition, 2013.
2. Steven F. Barrett, "Embedded System Design with the Atmel AVR Microcontroller", Morgan & Claypool, 2009.

Course Outcomes:

1. Understand the fundamentals of embedded system development tools Atmel RISC Processors.
2. Able to write C programs for Microcontrollers for small projects.
3. Understand the concepts of IDE and AVR families.
4. Able to make small projects on Ardunio Uno and application.

ECE119	MIMO Communication System	3-0-0	Credits 3

Course objectives:

1. To learn about basic MIMO communication systems.
2. To provide a comprehensive coverage of coding techniques for multiple input.
3. Compare MIMO Systems with Single Input Single Output (SISO) Systems.

4. Knowledge on MIMO systems for frequency-selective (FS) fading channels.
5. To study space-time block codes, Space-time trellis codes, Turbo codes and iterative decoding for MIMO systems.

MODULE-I **(12 Hours)**

Overview on MIMO and Fading Channels

Wireless channels, Introduction to Multi-antenna Systems, Multiple antennas in wireless communications, types of multi-antenna systems, MIMO vs. multi-antenna systems, Error/Outage probability over fading channels, MIMO frequency-selective channels.

MIMO Diversity and Spatial Multiplexing

Diversity techniques, Sources and types of diversity, analysis under Rayleigh fading, Diversity and channel knowledge, exploiting multipath diversity. MIMO spatial multiplexing, BLAST receivers and Diversity multiplexing trade-off.

MODULE-II **(10 Hours)**

Capacity and Information Theoretic aspects of MIMO channels

Review of SISO fading communication channels, MIMO channel models, Frequency selective and correlated channel models, Capacity of MIMO channels, Capacity of non-coherent MIMO channels, Ergodic and outage capacity, Capacity bounds and influence of channel properties on the capacity.

MODULE-III **(10 hours)**

Space Time Block Codes

Transmit diversity with two antennas, Space time block codes on real and complex orthogonal designs, Code design criteria for quasi-static channels (Rank, determinant and Euclidean distance), Orthogonal designs, Generalized orthogonal designs, Quasi-orthogonal designs and Performance analysis.

MODULE-IV **(10 Hours)**

Space Time Trellis Codes

Representation of STTC, shift register, generator matrix, state-transition diagram, trellis diagram, Code construction, Delay diversity as a special case of STTC and Performance analysis.

Text Books:

1. David Tse and PramodViswanath, "Fundamentals of Wireless Communication", Cambridge University Press, 2005.
2. Tolga M. Duman and Ali Ghrayeb, *"*Coding for MIMO Communication systems*",* John Wiley & Sons, 2007.

3. Ezio Biglieri , Robert Calderbank, "MIMO Wireless Communications" Cambridge University Press, 2007.

Reference Books:

1. E.G. Larsson and P. Stoica, "Space-Time Block Coding for Wireless Communications", Cambridge University Press, 2008.
2. Hamid Jafarkhani, "Space-Time Coding: Theory and Practice", Cambridge University Press, 2005.

Course outcomes:

1. Compare MIMO Systems with Single Input Single Output (SISO) Systems.
2. Analyze the Information Theoretic advantages of MIMO Systems.
3. Introducing and analysis of space time codes.
4. Analyze the spatial multiplexing properties of MIMO.
5. Prove the existence of some space time codes.

ECE120	Remote Sensing and Advanced Techniques	3-0-0	Credits 3

Course Objectives:

1. To provide exposure to students in gaining knowledge on concepts and applications leading to modeling of earth resources management using Remote Sensing.
2. To acquire skills in storing, managing digital data for planning and development.

MODULE-I **(10 Hours)**

Introduction and Basic Concepts of Remote sensing

Introduction, Basic concepts of remote sensing, Airborne and space born sensors, Passive and active remote sensing, Energy interactions in the atmosphere, Energy interactions with earth surface features, Spectral reflectance curves.

MODULE-II **(10 Hours)**

Remote sensing systems

Satellites and orbits, Polar orbiting satellites, Spectral, radiometric and spatial resolutions, Temporal resolution of satellites, Multispectral, thermal and hyperspectral sensing, Some remote sensing satellites and their features.

MODULE-III **(10 Hours)**

Digital Image Processing - Image Restoration

Geometric corrections, Co-registration of Data, Ground Control Points (GCP), Atmospheric corrections, Solar illumination corrections, Concept of color, Color composites, Filtering techniques, Edge enhancement, Density slicing, Thresholding, Intensity-Hue-Saturation (IHS) images, Time composite images, Synergetic images.

MODULE-IV **(12 Hours)**

Remote Sensing Applications and

Watershed management, Rainfall-runoff modeling, Irrigation management, Environmental monitoring.

Advanced Topics

Microwave remote sensing, sources of microwave data, Global positioning System (GPS), GPS for ground truth collection.

Text Books:

1. T.M. Lillesand and R.W. Kiefer, "Remote Sensing and Image Interpretation", John Wiley & Sons, 2002.
2. J.B. Cambell, "Introduction to Remote Sensing", Taylor & Francis, UK, 2002.

Reference Books:

1. F.F. Sabins "Remote Sensing - Principles and Interpretation", W.H. Freeman & Co, 1986.
2. R.A. Schowengerdt, "Remote Sensing - Models and Methods for Image Processing", Elsevier, 2006.

Course Outcomes:

1. Fully equipped with concepts, methodologies and applications of Remote Sensing Technology.
2. Acquire skills in handling instruments, tools, techniques and modeling while using Remote Sensing Technology

ECC103	Advance Communication and Network Lab	0-0-4	Credits 2

Experiment List

1. Design a FM receiver using Software Defined Radio kit.
2. Design a transmitter model with Software Defined Radio starter kit.
3. Design a voice transmitter and receiver model to transmit and receive voice signal using SDR starter kit.
4. Transmission and reception of a text file with SDR starter kit by using FSK modulation and demodulation technique.
5. Design a GSM receiver with SDR starter kit and observe the output on a spectrum analyzer.
6. Measurement of wavelength and voltage standing wave ratio by using Reflex Klystron.
7. Study of directional couplers to measure insertion loss, coupling and directivity.
8. Find out the Numerical Aperture and V number estimation of the single mode optical fiber.
9. Determine the insertion loss and loss uniformity of each channel of a WDM multiplexer.
10. Determine the optical cross talk in adjacent channels of WDM demultiplexer for various wavelengths.

ECC104	Design and Simulation Lab I	0-0-4	Credits 2

Experiment List

1. Simulation to realize the OFDM transmission system (without fading and with fading), BER, CCDF and PAPR analysis.
2. Simulation to realize various coding schemes for wireless communication system and their performance analysis.
3. Design and simulation of Rectangular patch antenna.
4. Design and simulation of Dipole antenna.
5. Design and simulation of Slot antenna.
6. Write a program to detect a target in clutter with low SNR.
7. Write a program to detect multiple targets in low probability of detection and low SNR.
8. Simulate an energy consumption model by incorporating MIMO techniques in a wireless sensor network.
9. Investigate the characteristics of PIN and Avalanche photodiodes.
10. Characterize analytically and through simulation the effects of dispersion on optical systems.

ECC203	Wireless Sensor Networking Lab	0-0-4	Credits 2

Experiment List

1. Design of IoT based home automation system (Prototype).
2. Design of IoT based home security system (Prototype).
3. Design of IoT based water level monitoring system (Prototype).
4. Design of IoT based motor speed control (Prototype).
5. Design of IoT based smart irrigation system (Prototype).
6. Component identification and set up to develop a wireless sensor network.
7. Configure a wireless sensor network to measure atmospheric temperature, humidity, pressure using different sensors.
8. Design and interfacing Robot with light follower and line follower.
9. Design and interfacing Robot with Zig-Bee communication.

ECC204	Design and Simulation Lab II	0-0-4	Credits 2

Experiment List

1. Simulation to realize the OFDM transmission system (without fading and with fading), BER, CCDF and PAPR analysis.
2. Simulation to realize various coding schemes for wireless communication system and their performance analysis.
3. Design and simulation of Rectangular patch antenna.
4. Design and simulation of Dipole antenna.
5. Design and simulation of Slot antenna.
6. Write a program to detect a target in clutter with low SNR.
7. Write a program to detect multiple targets in low probability of detection and low SNR.
8. Simulate an energy consumption model by incorporating MIMO techniques in a wireless sensor network.
9. Investigate the characteristics of PIN and Avalanche photodiodes.
10. Characterize analytically and through simulation the effects of dispersion on optical systems.

GHM101	Research Methodology & Intellectual Property Rights	2-0-0	Credits 2

MODULE-I **(06 Hours)**

Meaning of research problem, Sources of research problem, Criteria characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.

Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

MODULE-II **(04 Hours)**

Effective literature studies approaches, analysis,

Plagiarism, Research ethics.

MODULE-III **(04 Hours)**

Effective technical writing, how to write report, Paper.

Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

MODULE-IV **(06 Hours)**

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

MODULE-V **(04 Hours)**

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

MODULE-VI **(04 Hours)**

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Text/Reference Books:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science& engineering students".
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.

5. Mayall, “Industrial Design”, McGraw Hill, 1992.
6. Niebel, “Product Design”, McGraw Hill, 1974.
7. Asimov, “Introduction to Design”, Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “Intellectual Property in New Technological Age”, 2016.
9. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008

Course Outcomes: At the end of the course, students will be able to

1. Understand research problem formulation.
2. Analyze research related information
3. Follow research ethics
4. Understand that today’s world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property.

   Right to be promoted among students in general & engineering in particular.
6. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Audit Courses

AHM101	English for Research Paper Writing	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Understand that how to improve your writing skills and level of readability
2. Learn about what to write in each section
3. Understand the skills needed when writing a Title

   Ensure the good quality of paper at very first-time submission

MODULE-I **(4 Hours)**

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

MODULE-II **(4 Hours)**

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction.

MODULE-III **(4 Hours)**

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

MODULE-IV **(4 Hours)**

key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed whenwriting a Review of the Literature.

MODULE-V **(4 Hours)**

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions.

MODULE-VI **(4 Hours)**

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

Suggested Studies:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book.

4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

ACE101	Disaster Management	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

MODULE-I **(4 Hours)**

Introduction

Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

MODULE-II **(4 Hours)**

Repercussions of Disasters and Hazards:

Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem.

Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

MODULE-III **(4 Hours)**

Disaster Prone Areas In India

Study of Seismic Zones; Areas Prone To Floods And Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics

MODULE-IV **(4 Hours)**

Disaster Preparedness and Management

Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data From Meteorological and Other Agencies, Media Reports: Governmental and

Community Preparedness.

MODULE-V **(4 Hours)**

Risk Assessment

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategiesfor Survival.

MODULE-VI **(4 Hours)**

Disaster Mitigation

Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation In India.

Text / Reference Books:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies, NewRoyal book Company.
2. Sahni, Pardeep Et.Al. (Eds.)," Disaster Mitigation Experiences and Reflections", Prentice Hall OfIndia, New Delhi.
3. Goel S. L., Disaster Administration and Management Text and Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi.

AHM102	Sanskrit for Technical Knowledge	2-0-0	Credits 0

Course Objectives:

1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. Learning of Sanskrit to improve brain functioning
3. Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power
4. The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature

MODULE-I **(8 Hours)**

- Alphabets in Sanskrit
- Past/Present/Future Tense
- Simple Sentences

MODULE-II **(8 Hours)**

- Order
- Introduction of roots
- Technical information about Sanskrit Literature

MODULE-III **(8 Hours)**

- Technical concepts of Engineering-Electrical, Mechanical,Architecture, Mathematics

Suggested reading:

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

Course Output: Students will be able to

1. Understanding basic Sanskrit language
2. Ancient Sanskrit literature about science & technology can be understood
3. Being a logical language will help to develop logic in students

AHM103	Value Education	2-0-0	Credits 0

Course Objectives: Students will be able to

1. Understand value of education and self- development
2. Imbibe good values in students
3. Know about the importance of character

MODULE-I **(6 Hours)**

- Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism.
- Moral and non- moral valuation. Standards and principles.
- Value judgements

MODULE-II **(6 Hours)**

- Importance of cultivation of values.
- Sense of duty.Devotion, Self-reliance.Confidence, Concentration. Truthfulness, Cleanliness.
- Honesty, Humanity.Power of faith, National Unity.
- Patriotism.Love for nature, Discipline

MODULE-III **(6 Hours)**

- Personality and Behavior Development - Soul and Scientific attitude.
- Positive Thinking. Integrity and discipline.
- Punctuality, Love and Kindness.
- Avoid fault Thinking.
- Free from anger, Dignity of labour.
- Universal brotherhood and religious tolerance.
- True friendship.
- Happiness Vs suffering, love for truth.
- Aware of self-destructive habits.
- Association and Cooperation.
- Doing best for saving nature

MODULE-IV **(6 Hours)**

- Character and Competence –Holy books vs Blind faith.
- Self-management and Good health.
- Science of reincarnation.
- Equality, Nonviolence, Humility, Role of Women.
- All religions and same message.
- Mind your Mind, Self-control.
- Honesty, Studying effectively

Text / Reference Books

1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

Course outcomes: Students will be able to

1. Knowledge of self-development

2. Learn the importance of Human values
3. Developing the overall personality

AHM104	Constitution of India	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutionalrole and entitlement to civil and economic rights as well as the emergence of nationhood inthe early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the BolshevikRevolution in 1917 and its impact on the initial drafting of the Indian Constitution.

MODULE-I **(4 Hours)**

- **History of Making of the Indian Constitution:**

  History

  Drafting Committee, (Composition& Working)

MODULE-II **(4 Hours)**

- **Philosophy of the Indian Constitution:**

  Preamble

  Salient Features

MODULE-III **(4 Hours)**

- **Contours of Constitutional Rights & Duties:**

  Fundamental Rights

  Right to Equality

  Right to Freedom

  Right against Exploitation

  Right to Freedom of Religion

  Cultural and Educational Rights

  Right to Constitutional Remedies

  Directive Principles of State Policy

Fundamental Duties.

MODULE-IV **(4 Hours)**

- **Organs of Governance:**

  Parliament

  Composition

  Qualifications and Disqualifications

  Powers and Functions

  Executive

  President

  Governor

  Council of Ministers

  Judiciary, Appointment and Transfer of Judges, Qualifications

  Powers and Functions

MODULE-V **(4 Hours)**

- **Local Administration:**

  District's Administration head: Role and Importance,

  Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation.

  Pachayati raj: Introduction, PRI: ZilaPachayat.

  Elected officials and their roles, CEO ZilaPachayat: Position and role.

  Block level: Organizational Hierarchy (Different departments),

  Village level: Role of Elected and Appointed officials,

  Importance of grass root democracy

  Model Curriculum of Engineering & Technology PG Courses [Volume -II]

MODULE-VI **(4 Hours)**

- **Election Commission:**

  Election Commission: Role and Functioning.

  Chief Election Commissioner and Election Commissioners.

  State Election Commission: Role and Functioning.

  Institute and Bodies for the welfare of SC/ST/OBC and women.

Text / Reference Books:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Outcomes: Students will be able to:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the passage of the Hindu Code Bill of 1956.

AHM105	Pedagogy Studies	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Review existing evidence on the review topic to inform programme design and policymaking undertaken by the DfID, other agencies and researchers.
2. Identify critical evidence gaps to guide the development.

MODULE-I **(4 Hours)**

- **Introduction and Methodology:**

- Aims and rationale, Policy background, Conceptual framework and terminology
- Theories of learning, Curriculum, Teacher education.
- Conceptual framework, Research questions**.**
- Overview of methodology and Searching.

MODULE-II **(2 Hours)**

- Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries.
- Curriculum, Teacher education.

MODULE-III **(4 Hours)**

- Evidence on the effectiveness of pedagogical practices
- Methodology for the in depth stage: quality assessment of included studies.
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?
- Theory of change.
- Strength and nature of the body of evidence for effective pedagogical practices.
- Pedagogic theory and pedagogical approaches.
- Teachers' attitudes and beliefs and Pedagogic strategies.

MODULE-IV **(4 Hours)**

- Professional development: alignment with classroom practices and follow up support
- Peer support
- Support from the head teacher and the community.
- Curriculum and assessment
- Barriers to learning: limited resources and large class sizes

MODULE-V **(2 Hours)**

- **Research gaps and future directions**
- Research design
- Contexts
- Pedagogy
- Teacher education
- Curriculum and assessment
- Dissemination and research impact.

Text / Reference Books:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2):245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal ofCurriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International JournalEducational

Development, 33 (3): 272–282.

5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

Course outcomes: Students will be able to understand:

1. What pedagogical practices are being used by teachers in formal and informal classrooms indeveloping countries?
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, andwith what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

AHM106	Stress Management by Yoga	2-0-0	Credits 0

Course Objectives:

1. To achieve overall health of body and mind
2. To overcome stress

MODULE-I **(8 Hours)**

- Definitions of Eight parts of yoga. (Ashtanga)

MODULE-II **(8 Hours)**

- Yam and Niyam.

  Do`s and Don't's in life.

  i) Ahinsa, satya, astheya, bramhacharya and aparigraha

  ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

MODULE-III **(8 Hours)**

- Asan and Pranayam

  i) Various yog poses and their benefits for mind & body

  ii) Regularization of breathing techniques and its effects-Types of pranayam

Text / Reference Books:

1. 'Yogic Asanas for Group Tarining-Part-I" :Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

Course outcomes: Students will be able to:

1. Develop healthy mind in a healthy body thus improving social health also
2. Improve efficiency

AHM107	Personality Development through Life Enlightenment Skills	2-0-0	Credits 0

Course Objectives:

1. To learn to achieve the highest goal happily
2. To become a person with stable mind, pleasing personality and determination
3. To awaken wisdom in students

MODULE-I **(8 Hours)**

Neetisatakam-Holistic development of personality

- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)
- Verses- 52,53,59 (dont's)
- Verses- 71,73,75,78 (do's)

MODULE-II **(8 Hours)**

Approach to day to day work and duties.

- Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48,
- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,
- Chapter 18-Verses 45, 46, 48.

MODULE-III **(8 Hours)**

Statements of basic knowledge.

- Shrimad Bhagwad Geeta: Chapter 2-Verses 56, 62, 68

- Chapter 12 -Verses 13, 14, 15, 16,17, 18
- Personality of Role model. Shrimad Bhagwad Geeta: Chapter 2-Verses 17, Chapter 3-Verses 36,37,42,
- Chapter 4-Verses 18, 38,39
- Chapter 18 – Verses 37,38,63

Text / Reference Books:

1. "Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

Course outcomes: Students will be able to:

1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity
3. Study of Neetishatakam will help in developing versatile personality of students.

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

M.TECH SYLLABUS for *Specialization*: WIRELESS COMMUNICATION TECHNOLOGY

BRANCH: ELECTRONICS AND TELECOMMUNICATION ENGINEERING (2018-19 Admission Batch)

First Semester				Second Semester			
Theory				**Theory**			
Course Code	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**	**Course Code**	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**
ECC101	**Programme Core-1** Advanced Communication Techniques	3-0-0	3	ECC201	**Programme Core-3** Information Theory And Coding	3-0-0	3
ECC102	**Programme Core-2** Adaptive Signal Processing	3-0-0	3	ECC202	**Programme Core-4** Advanced Wireless Communication	3-0-0	3
	Programme Elective-1 (Any One) To be chosen from list of Electives	3-0-0	3		**Programme Elective-3 (Any One)** To be chosen from list of Electives	3-0-0	3
	Programme Elective-2 (Any One) To be chosen from list of Electives	3-0-0	3		**Programme Elective-4 (Any One)** To be chosen from list of Electives	3-0-0	3
GHM101	Research Methodology & Intellectual Property Rights	2-0-0	2				
	Audit Course-1 (Any One from the list of Audit Courses)	2-0-0	0		**Audit Course-2 (Any One from the list of Audit Courses)**	2-0-0	0
	Total (Theory)	**16**	**14**		**Total (Theory)**	**14**	**12**
	Practical/ Sessional				**Practical/ Sessional**		
ECC103	**Lab-1** Advance Communication and Network Lab	0-0-4	2	ECC203	**Lab-3** Wireless Sensor Networking Lab	0-0-4	2
ECC104	**Lab-2** Design and Simulation Lab I	0-0-4	2	ECC204	**Lab-4** Design And Simulation Lab II	0-0-4	2
				WCJ201	**Mini Project with Seminar**		
	Total (Practical/ Sessional)	**8**	**4**		**Total (Practical/ Sessional)**	**12**	**6**
	TOTAL	**24**	**18**		**TOTAL**	**26**	**18**
TOTAL SEMESTER CREDITS: 18				TOTAL SEMESTER CREDITS: 18			
TOTAL CUMULATIVE CREDITS: 18				TOTAL CUMULATIVE CREDITS: 36			

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

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BRANCH: ELECTRONICS AND TELECOMMUNICATION ENGINEERING (2018-19 Admission Batch)

Third Semester				Fourth Semester			
Theory				**Theory**			
Course Code	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**	**Course Code**	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**
	Programme Elective-5 (Any One) To be chosen from list of Electives	3-0-0	3				
	Open Elective (Any One) Business Analytics Industrial Safety Operations Research Cost Management of Engineering Projects Composite Materials Waste to Energy Internet of Things Soft Computing Project Engineering & Management Start-up & Entrepreneurship Development	3-0-0	3				
	Total (Theory)	**6**	**6**		**Total (Theory)**	**0**	**0**
	Practical/ Sessional				**Practical/ Sessional**		
WCJ301	Dissertation Phase-I	0-0-20	10	WCJ401	Dissertation Phase-II	0-0-32	16
	Total (Practical/ Sessional)	**20**	**10**		**Total (Practical/ Sessional)**	**32**	**16**
	TOTAL	**26**	**16**		**TOTAL**	**32**	**16**
TOTAL SEMESTER CREDITS: 16				TOTAL SEMESTER CREDITS: 16			
TOTAL CUMULATIVE CREDITS: 52				TOTAL CUMULATIVE CREDITS: 68			

List of Audit courses

1	AHM101	English for Research Paper Writing
2	ACE101	Disaster Management
3	AHM102	Sanskrit for Technical Knowledge
4	AHM103	Value Education
5	AHM104	Constitution of India
6	AHM105	Pedagogy Studies
7	AHM106	Stress Management by Yoga
8	AHM107	Personality Development through Life Enlightenment Skills

List of Programme Elective Subjects

SL. No.	Subject Code	Subject Name
1	ECE101	Optical Communication and Network
2	ECE102	Internet Of Things
3	ECE103	Pattern Recognition and Machine Learning
4	ECE104	Modern Radar System
5	ECE105	Computational Intelligence
6	ECE106	Telecommunication Switching and Network
7	ECE107	Data Security and Cryptography
8	ECE108	Fiber Optics Devices and Components
9	ECE109	Cognitive Radio System
10	ECE110	VLSI for Wireless Communication
11	ECE111	Satellite Communication System
12	ECE112	Wireless Sensor Network
13	ECE113	Security in Wireless and Mobile Communication
14	ECE114	Antenna Theory and Design
15	ECE115	Optical Wireless Communication
16	ECE116	Mathematics for Communication Engineers
17	ECE117	Multimedia Communication
18	ECE118	Embedded System Design
19	ECE119	MIMO Communication System
20	ECE120	Remote Sensing and Advanced Techniques

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

M.TECH SYLLABUS for *Specialization*: WIRELESS COMMUNICATION TECHNOLOGY

BRANCH: ELECTRONICS AND TELECOMMUNICATION ENGINEERING (2018-19 Admission Batch)

ECC101	Advanced Communication Techniques	3-0-0	Credits 3

Course Objectives:

1. To understand the band pass modulation and demodulation.
2. To be aware with the concepts of multichannel and multicarrier systems & spread spectrum techniques.
3. To understand the error control coding perception and equalization techniques.
4. To be familiarize with advance ideas of Fading & Communication Link Analysis.

MODULE-I **(12 Hours)**

Digital Modulation Scheme

Mathematical models for communication channels & their characteristics**,** Representation of Digitally Modulated Signals, Memoryless Modulation Methods; Signalling schemes with memory; Linear modulation with memory, MSK , GMSK, Continuous-Phase Frequency-Shift Keying; Overview of AWGN Channel, Detection of Binary Signals in Gaussian Noise, Detection of Signals in Gaussian Noise.

Carrier and Symbol Synchronization

Signal Parameter estimation; Carrier phase estimation; Symbol timing estimation; Joint estimation.

MODULE-II **(12 Hours)**

Multichannel and Multicarrier Systems

Multichannel Digital Communications in AWGN Channels; Multicarrier Communications; Single Carrier verses Multicarrier Modulation, Introduction to OFDM, Modulation & Demodulation in an OFDM, Principle of multi path propagation, Impulse response model of channels, parameters for mobile multi path channels.

Spread Spectrum Techniques

Spread-Spectrum Overviews, Pseudonoise Sequences, Direct-Sequence, Spread-Spectrum Systems, Frequency Hopping Systems, Synchronization, Jamming Considerations, Commercial Applications, Cellular Systems.

MODULE-III **(8 Hours)**

Error Control Coding

Introduction & Basic definition to Linear Block Codes; equivalent codes, syndrome decoding, Hamming Codes, Optimal Linear codes; ConvolutionCodes: Representation of codes using polynomial, State diagram, Tree Codes and Trellis Codes, Viterbi algorithm.

EqualizationTechnique

Linear equalizer and nonlinear equalization, algorithms for adaptive equalization.

MODULE-IV **(10 Hours)**

Fading Channels

The Challenge of Communicating over Fading Channels, Characterizing, Mobile-Radio Propagation, Signal Time-Spreading, Time Variance of the Channel Caused by Motion Mitigating the Degradation Effects of Fading, Summary of the Key Parameters Characterizing Fading Channels, Applications: Mitigating the Effects of Frequency Selective Fading.

Communications Link Analysis

Channel and sources of signal loss, Received Signal Power and Noise Power, Link Budget Analysis, Noise Figure, Noise Temperature, and System Temperature, Sample Link Analysis, Satellite Repeaters.

Text Books:

1. J. G. Proakis and Masoud Salehi, "Digital Communications", Mc Graw Hill, 5th edition, 2008.
2. Bernard Sklar, "Digital Communications – Fundamentals and applications", Pearson education, 2nd edition, 2001.
3. T. S. Rappaport, "Wireless Communications", Pearson Education, 2nd Edition, 2007.

Reference Books:

1. Itisaha Mishra, "Wireless Communications & Network 3G and beyond", Tata Mc-Graw Hill, 2nd edition, 2013.
2. J. G. Proakis, M. Salehi, "Communication Systems Engineering", Pearson Education International, 2002.
3. Ranjan Bose, "Information Theory, Coding and Cryptography", Tata McGraw-Hill, 2nd edition, 2008.

Course Outcomes:

1. Select modulation and detection techniques for a given communication link.
2. Design optimal coding schemes for efficient use of channel capacity.
3. Understanding various formatting & modulation process.
4. Acquiring knowledge on the theory of communication link analysis.
5. Detailed perception of Spread Spectrum Techniques, Fading Channels, etc.

ECC102	Adaptive Signal Processing	3-0-0	Credits 3

Course Objectives:

1. Use of adaptive filtering algorithms and structures to learn the optimal filter or estimator and track time-varying system dynamics in order to improve the performance over static, fixed filtering techniques.
2. To implement adaptive systems with application to digital communications, beam forming, control systems, and interference cancellation.
3. To create an adaptive equalizer for digital communications over a time-varying channel.

MODULE-I **(10 Hours)**

ADAPTIVE SYSTEMS:

Characteristics, Areas of application, general properties, open and closed loop adaptation, applications of closed loop adaptation, Example of an Adaptive System, The Adaptive Linear Combiner: Description, Weight Vectors, Desired Response, Performance Function; Gradient and Minimum Mean-Square Error. Approaches to the Development of Adaptive Filter Theory: Introduction to Filtering Smoothing and Prediction-Linear Optimum Filtering, Problem Statement, Principle of Orthogonality, Minimum–Mean-Squared Error, Wiener–Hopf Equations, Error Performance, Normal Equation.

MODULE-II **(10 Hours)**

GRADIENT SEARCHING AND ESTIMATION:

Searching the Performance Surface – Methods and Ideas of Gradient Search Methods, Gradient Searching Algorithm and its Solution, Stability and Rate of Convergence, Learning Curves, Gradient Search by Newton's Method, Method of Steepest Descent, and Comparison of Learning Curves. Gradient component estimation by derivative measurement, the performance penalty, derivative measurement and performance penalties with multiple weights, variance of the gradient estimate, effects on the weight vector solution.

MODULE-III **(12 Hours)**

LMS & RLS ALGORITHMS:

Overview, LMS Adaptation Algorithms, Stability and Performance Analysis of LMS Algorithms, LMS Gradient and Stochastic Algorithms, Convergence of LMS Algorithms, RLS algorithms.

ADAPTIVE MODELING AND SYSTEM IDENTIFICATION:

General description, adaptive modeling of multipath communication channel, adaptive modeling in geophysical exploration, adaptive modeling in FIR digital filter synthesis, general description of inverse modeling, some theoretical examples.

MODULE-IV **(10 Hours)**

KALMAN FILTERING THEORY:

Introduction, Recursive Mean Square Estimation for Scalar Random Variables, Statement of Kalman Filtering Problem, Innovation Process. Estimation of State using the Innovation Process, Filtering, Initial Conditions,

Summary of Kalman Filters, Variants of the Kalman Filtering, the Extend Kalman Filtering, Identification as a Kalman Filtering Problem.

Text Books:

1. Bernand Widrow and Samuel D. Stearns, "Adaptive Signal Processing", Pearson Education, 2009.
2. Simon Haykins, "Adaptive filter Theory", PHI, 2003.

Reference Books:

1. Sophocles J. Orfamidis, "Optimum Signal Processing – An Introduction", 2nd edition, McGraw Hill, 2005.
2. S. Thomas Alexander, "Adaptive Signal Processing – Theory and Applications", Springer Verlag, 1986.
3. Tulay Adali, Simon Haykin, "Adaptive Signal Processing – Next Generation Solutions", Wiley, 2012.

Course Outcomes:

1. Comprehend design criteria and modeling adaptive systems and theoretical performance evaluation.
2. Design a linear adaptive processor.
3. Able to apply mathematical models for error performance and stability.
4. Able to apply adaptive modeling systems for real time applications.
5. Comprehend the estimation theory for linear systems and modeling algorithms.

ECC201	Information Theory and Coding	3-0-0	Credits 3

Course Objectives:

1. Fundamental concept of entropy and information as they are used in communications.
2. To enhance knowledge about source coding and channel capacity of information.
3. To fundamental theories and laws of error control codes, cyclic codes and BCH codes.

MODULE-I **(11 Hours)**

Source Coding

Introduction to information theory, uncertainty of information, Information measure, entropy, source coding theorem, Huffman Coding, run length encoding, rate distortion function, JPEG and MPEG standards in image compression.

Channel Capacity and Coding

Channel models, Channel Capacity, Channel Coding, Information Capacity Theorem, Shannon Limit.

MODULE-II **(10 Hours)**

Error Control Coding

Linear Block Codes: Introduction, Basic definition, equivalent codes, parity check matrix, decoding, syndrome decoding, Perfect Codes, Hamming Codes, Optimal Linear codes.

Cyclic Codes

Introduction polynomials, The division Algorithm, Method for generating cyclic codes, Burst Error correction, Fire Codes, Golay Codes, CRC Codes, Circuit implementation.

MODULE-III **(11 Hours)**

Convolutional Codes

Introduction, Tree Codes and Trellis Codes, Polynomial description, The Generating function, Matrix Description, Viterbi Decoding, Distance bounds, Turbo Codes, Turbo Decoding.

MODULE-IV **(10 Hours)**

Trellis Coded Modulation (TCM)

Introduction, the concept of coded modulation, Mapping by set Partitioning, Design rules, TCM Decoder.

Text Books:

1. Ranjan Bose, "Information Theory, Coding and Cryptography", Tata McGraw-Hill, 2nd edition, 2008
2. John M. Senior, "Optical Fiber Communications", Pearson, 3rd edition, 2010.
3. J. G. Proakis, "Digital Communications", McGraw-Hill Publication, 3rd edition, 1994.

Reference Books:

1. Shu lin and Daniel J. Costello, "Error Control Coding", Pearson Education India, 2011.
2. R. Avudaiammal, "Information Coding Techniques", Tat McGraw-Hill, 2nd edition, 2009.
3. Bernard Sklar, "Digital Communications - Fundamental and Applications", Pearson education Publication, 2nd edition, 2009.

Course Outcomes:

1. Evaluation of information content of a random variable from its probability distribution.
2. Knowledge about channel capacity using Shannon's Theorem.
3. Design of digital communication bycyclic, BCH, convolutional and TCM codes.

ECC202	Advanced Wireless Communication	3-0-0	Credits 3

Course Objectives:

1. Describe the type and appropriate model of wireless fading channel based on the system parameters and the property of the wireless medium.
2. Analyze and design receiver and transmitter diversity techniques.
3. Determine the appropriate transceiver design of multi-antenna systems and evaluate the data rate performance.
4. Distinguish the major cellular communication standards (1G/2G/3G systems).

MODULE-I **(11 Hours)**

Wireless Communication Channel Models

Introduction to wireless communications, Introduction to various wireless channel models (frequency flat, frequency selective, Rayleigh and Ricean fading models) Diversity, Equalization and Cellular Communications.

MODULE-II **(10 Hours)**

Spread Spectrum Techniques

Introduction to CDMA and associated standards, Introduction to the notion of channel capacity, Capacity of scalar wireless channels, Capacity of time invariant channels, Capacity of time varying (or fading) channels.

OFDM

Introduction to OFDM, OFDM mathematical representation, windowing in OFDM signal and spectral efficiency Synchronization in OFDM, Pilot Insertion in OFDM, Amplitude limitations in OFDM, CDMA vs OFDM, Hybrid OFDM and Variants of OFDM.

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MODULE-III **(11 Hours)**

MIMO Systems

MIMO: Space Diversity and systems based on space diversity, Smart antenna system and MIMO, MIMO exploits Multipath, Space-Time Processing, Antenna considerations for MIMO, MIMO channel modeling, measurement, and Capacity, Cyclic Delay Diversity (CDD), Space-Time coding, Advances and Applications of MIMO, MIMO-OFDM. Capacity of time varying (fading) channels, Capacity of vector (MISO, SIMO, MIMO) channels and spatial multiplexing.

MODULE-IV **(10 Hours)**

Wireless Broadcast Networks

Wireless Broadcast Networks: Digital Audio Broadcasting (DAB), Digital Radio Mondiale (DRM), HD Radio Technology, Digital Video Broadcasting (DVB), Direct to Home (DTH).

Wireless Cellular and Ad Hoc Networks: GSM System, GPRS, EDGE Technology, CDMA-based Digital

Cellular Standards, WLL, IMT-2000, Mobile Satellite Communication, 3G, 4G and Beyond. Bluetooth, Wi-Fi Standards, WiMAX standards, Wireless sensor networks, IEEE 802.15.4 and Zigbee, UWB, IEEE 802.20 and beyond

Text Books:

1. David Tse and Pramod Viswanath, "Fundamentals of wireless communications", Cambridge University Press, 1st edition, 2012.
2. Upena Dalal, "Wireless Communication", Oxford University Press, 2009.
3. E. Biglieri, "MIMO Wireless Communications", Cambridge University Press, 2007.

Reference Books:

1. T. S. Rappaport, "Wireless Communications: Principles and Practice", Prentice Hall of India, 2nd Edition, 2007.
2. A. Goldsmith, "Wireless Communications", Cambridge University Press, 2005.

Course Outcomes:

1. Understand Distinguish the trade-offs among frequency reuse, channel capacity, and spectral efficiency.
2. Illustration of path loss and shadowing effect.
3. Knowledge on various diversity techniques & simple equalization schemes.
4. Characterization of multiple access schemes.

ECE101	Optical Communication and Network	3-0-0	Credits 3

Course Objectives:

1. To be familiar with optical fiber communication.
2. To gain knowledge of different types of optical fiber and optical fiber components.
3. To have knowledge over ray optics and wave representation of light in fiber communication.
4. To have a detail understanding of fiber communication network.

MODULE-I **(11 Hours)**

Overview of Optical Fiber Communication, Optical Fiber: Structure, Waveguiding, Fabrication

Introduction to optical communication: Evolution of Fiber Optic Systems, Basic optical laws and definition, Optical fiber modes and configuration, Ray optics representation, Wave representation, mode theory for circular wave guide, modes in step index fiber, linearly polarised modes, propagation modes in single mode fibers. Graded index fiber structure, graded-index numerical aperture (NA). Elementary ideas on fiber materials, fabrication and fiber optic cables.

MODULE-II **(10 Hours)**

Signal Degradation and Distortion in Optical Fiber, Optical Amplifier

Signal degradation in Optical fibers, Attenuation, Absorption, Scattering losses, bending losses, core and cladding losses. Signal distortion in optical wave guides. Information capacity of optical fibers. Material dispersion, wave guide dispersion, inter modal dispersion. Optical amplifier- EDFA, Raman amplifier.

MODULE-III **(11 Hours)**

Optical Sources, Photodetectors, Optical Receiver Operation, Digital Transmission System

Basic ideas of light sources and their principle of operation (LEDs and LASERs), power-bandwidth product of LEDs and resonant frequencies of LASER diodes. Physical principles of photo detectors, Avalanche photo diodes. Optical receiver operation (Fundamentals): Digital signal transmission, error sources, Digital transmission systems, link power budget, Rise time budget.

MODULE-IV **(10 Hours)**

Fiber Optic Networking

Introduction to Optical Networks (SONET, IP), Optical layer, Transparency and All-Optical Networks, Optical Packet Switching, Fibre Optic Network Topology & principles, LAN, MAN, FDDI networking. Multiplexing methods in fibre optic networks. Concepts of WDM and TDM.

Text Books:

1. Gerd Keiser, "Optical Fiber Communications", TMH, 4th edition, 2008.
2. John M. Senior, "Optical Fiber Communications", Pearson, 3rd edition, 2010.
3. R. Ramaswami, K. N. Sivarajan, G. H. Sasaki, "Optical Networks: A Practical Perspective", OSA, 3rd edition, 2009.

Reference Books:

1. Govind P. Agrawal, "Fiber Optic Communication Systems", John Wiley, 3rd edition, 2004.
2. Joseph C. Plais, "Fiber Optic Communication", Pearson Education, 4th edition, 2004.
3. G.K. Sarkar, D.C. Sarkar, "Opto Electronics and Fiber optic Communication", New Age International, 2nd edition, 2013.

Course Outcomes:

1. Understand the principles of fiber-optic communication and the bandwidth advantages.
2. Understand the properties of optical fibers and optical components.
3. Understand operation of lasers, LEDs, and detectors.
4. Analyze system performance of optical communication systems.
5. Design optical networks and understand non-linear effects in optical fibers.

ECE102	Internet Of Things	3-0-0	Credits 3

Course Objectives:

1. Vision and Introduction to IoT.
2. Vision and IoT Market perspective.
3. Data and Knowledge Management and use of Devices in IoT Technology.
4. Understand state of the Art-IoT Architecture.
5. Real World IoT Design Constraints, Industrial Automation and Commercial Building Automation IoT.

MODULE-I **(10 Hours)**

Introduction to Internet of Things

Introduction-Definition & Characteristics of IoT, Physical Design of IoT- Things in IoT, IoT Protocols, Logical Design of IoT- IoT Functional Blocks, IoT Communication Models, IoT Communication APIs, IoT Enabling Technologies- Wireless Sensor Networks, Cloud Computing, Big Data Analytics, Communication Protocols, Embedded Systems, IoT Levels & Deployment Templates.

MODULE-II **(09 Hours)**

Domain Specific IoTs

Home Automation: Smart Lighting, Smart Appliances, Intrusion Detection, Smoke/Gas Detectors, Cities-Smart Parking, Smart Lighting, Smart Roads, Environment-Weather Monitoring, Air Pollution Monitoring, Noise Pollution Monitoring, Forest Fire Detection, River Floods Detection, Energy- Smart Grids, Agriculture-Smart Irrigation.

IoT and M2M Introduction, M2M-Difference between IoT and M2M, SDN and NFV for IoT-Software Defined Networking, Network Function Virtualization

MODULE-III **(10 Hours)**

IoT Platforms Design Methodology

IoT Design Methodology-Purpose & Requirements Specification, Process Specification, Domain Model Specification, Information Model Specification, Service Specifications, IoT Level Specification, Functional View, specifications, operational view specification, Device & Component Integration, Application Development.

What is an IoT Device-Basic building blocks of an IoT Device, Exemplary Device: Raspberry Pi, About the Board, Linux on Raspberry Pi, Raspberry Pi Interfaces – Serial, SPI, I2C, Programming

Raspberry Pi with Python-Controlling LED with Raspberry Pi, interfacing an LED and Switch with Raspberry Pi, Interfacing a Light Sensor (LDR) with Raspberry Pi.

MODULE-IV **(13 Hours)**

IoT & Beyond

Use of Big Data and Visualization in IoT, Industry 4.0 Concepts.Overview of RFID, Overview of Android /

IOS App Development tools.

Text Books:

1. Arshdeep Bahga and Vijay Audisetti, "Internet of Things, A Hands on Approach", University Press, 1st edition, 2016.
2. Raj Kamal, "Internet of Things- Architecture and Design Principles", McGraw Hill, 1st edition, 2017.

Reference Books:

1. Adrian McEwen, "Designing the Internet of Things", Wiley, 1st edition, 2015.
2. Miller, "The Internet of Things: How Smart TVs, Smart Cars, Smart Homes and Smart Cities are Changing the World", Pearson, 1st edition, 2015.

Course Outcomes:

1. Understand the vision of IoT from global context.
2. Determine the market perspective of IoT.
3. Use of Devices, Gate ways and Data Management in IoT.
4. Building state of the art architecture in IoT.
5. Application of IoT in Industrial and Commercial Building Automation and Real world Design Constraints.

ECE103	Pattern Recognition and Machine Learning	3-0-0	Credits 3

Course Objective:

1. To provide an introduction to classical pattern recognition.
2. To provide links to the classical statistical pattern recognition techniques along with introductory concepts on neural network.
3. To understand applications of machine learning and neural network.

MODULE-I **(10 Hours)**

Probability Decision Theory

Risk Functions, Likelihood Functions, Decision Criteria, Decision Surfaces, Discriminant Functions, Gaussian Classifiers, Principal Component Analysis.

MODULE-II **(10 Hours)**

Receiver Operating Characteristics and DET Curves

Maximum Likelihood Estimation, Bias, Convergence ,Bayesian Parameter Estimation, Bayesian Learning, Principal Component Analysis, Advanced Discriminant Analysis.

MODULE-III **(12 Hours)**

Introduction to Hidden Markov Models (HMMs)

Parameter Estimation, Nonparametric Estimation Techniques, Support Vector Machines, Decision Trees Foundations of Machine Learning, Estimating, Comparing and Combining Classifiers, Clustering, Hierarchical Clustering, Discriminative Training, Statistical Significance.

MODULE-IV **(10 Hours)**

Introduction to Neural Networks

Regularization, Introduction to Deep Learning, training Deep Learning networks, Auto encoders and Convolutional Neural Networks, recurrent networks, Alternate Optimizers and Training Strategies, Applications: Sequential Decoding of Speech.

Text Books:

1. C.M. Bishop, "Pattern Recognition and Machine Learning", Springer, 1st edition, 2006.
2. R.O. Duda, P.E. Hart and D.G. Stork, "Pattern Classification", Wiley Inter science, 2001.

Reference Books:

1. D. J. C. MacKay, "Information Theory, Inference and Learning Algorithms", Cambridge University Press, 2004.

Course Outcomes:

1. Understand the theory, principles and algorithms used in machine learning to construct high performance information processing systems.
2. Familiarize with modern concepts for model selection and parameter estimation in recognition, decision making and statistical learning problems.
3. Knowledge on regression, classification, regularization, feature selection and density estimation in supervised mode of learning.

ECE104	Modern Radar System	3-0-0	Credits 3

Course Objectives:

1. Introduction to modern radar systems and signal processing techniques, for both civilian and defense applications.
2. Understand the design of radar signals.

3. Identify and explain engineering problems in relation to radar design.
4. Have an appreciation of future trends in radar, radar signal processing and new areas of application.

MODULE-I **(10 Hours)**

Introduction to Radar system and Signal Models

Review of selected signal processing concepts and operations, signal conditioning and interference suppression, detection and post processing. Signal models: Components of a radar signal, amplitude models, radar range equation and radar cross section.

MODULE-II **(12 Hours)**

Radar Waveform Design

The Matched filter, Matched filter for simple pulse, Range resolution of the Matched filter, Matched filtering for moving targets, The Ambiguity function: Definition and properties, Ambiguity function of a simple pulse, Range ambiguity, Doppler's ambiguity, Relation of slow time spectrum to ambiguity function.

MODULE-III **(10 Hours)**

Pulse Compression and Clutter

Basics of pulse compression, Time Bandwidth product, Linear frequency modulation, Clutter: Definition, Surface Clutter, Volume Clutter, Clutter spectrum, Clutter statistical models. Electronic Warfare: ESM, ECM, ECCM, IFM, types of jammers, calculation of Performance.

MODULE-IV **(10 Hours)**

Target Detection and Tracking

Basics of Target detection, Constant false Alarm Rate Detectors, Introduction to target tracking, Non-linear filtering, Data Association, Single target tracking, Multi target tracking.

Text Books:

1. M. A. Richards, "Fundamentals of radar signal processing", Tata McGraw-Hill, 2nd edition, 2005.
2. J. Scheer, and A. H. William, "Principles of modern radar", SciTech, 2010.

Reference Books:

1. M. Skolnik, "Introduction to Radar Systems", Tata McGraw Hill, 3rd edition, 2003.
2. H. Meikle, "Modern Radar Systems", Arctech House, 2nd edition, 2008.

Course Outcomes:

1. Understand the radar equation and its application.
2. Apply appropriate mathematical and computer models relevant to radar systems to calculate system

performance.

3. Understand the design of radar signals, and FM radar.
4. Analyze the performance of simple tracking radar systems.

ECE105	Computational Intelligence	3-0-0	Credits 3

Course Objective:

1. Knowledge of non-traditional technologies and fundamentals of artificial neural networks, fuzzy sets, fuzzy logic, Fuzzy Inference System and Genetic algorithms.
2. To provide ideas on fuzzification and defuzzification methods supported in fuzzy logic.
3. To understand the need for optimization and different techniques involved.

MODULE-I **(12 Hours)**

Introduction to Soft Computing

Soft computing constituents and conventional Artificial Intelligence, Neuro-Fuzzy and Soft Computing characteristics.

Fuzzy Sets, Fuzzy Rules and Fuzzy Reasoning

Introduction, Basic definitions and terminology, Set-theoretic operations, MF Formulation and parameterization, More on fuzzy union, intersection, and complement, Extension principle and fuzzy relations, Fuzzy If-Then rules, Fuzzy reasoning.

Fuzzy Inference System

Mamdani fuzzy models, Sugeno Fuzzy Models, Tsukamoto fuzzy models.

MODULE-II **(12 Hours)**

Derivative-based optimization

Descent methods, the method of steepest descent, Newton's methods, Step size determination, conjugate gradient methods, Analysis of quadratic case, nonlinear least-squares problems, Incorporation of stochastic mechanism.

Derivative-free optimization

Genetic algorithm simulated annealing, random search, Downhill simplex search, Swarm Intelligence, genetic programming.

Adaptive Networks

Architecture, Back propagation for feed forward networks, Extended back propagation for recurrent networks, Hybrid learning rule: combing steepest descent and LSE.

MODULE-III **(10 Hours)**

Supervised learning neural networks

Perceptions, Adaline, Back propagation multi layer perceptions, Radial Basic Function networks.

Unsupervised learning and other neural networks

Competitive learning networks, Kohonen self-organizing networks, learning vector quantization, Hebbian learning and the Hopfield network.

MODULE-IV **(8 Hours)**

Adaptive Neuro-fuzzy inference systems

ANFIS architecture, Hybrid learning algorithms, Learning methods that cross-fertilize ANFIS and RBNF, ANFIS as universal approximator, Simulation examples.

Text Books:

1. J. S. R. Jang, C. T. Sun and E. Mizutani, "Neuro-fuzzy and Soft Computing", PHI, 2005.
2. S. Rajasekaran, G. A. Vijaylakshmi Pai, "Neural Networks, Fuzzy Logic, and Genetic
3. Algorithms", PHI, 2001.

Reference Books:

1. George J. Klir and Bo Yuan, "Fuzzy Sets and Fuzzy Logic: Theory and Applications", Prentice Hall, 1995.

Course Outcomes:

1. Apply fuzzy logic and reasoning to handle uncertainty and solve various engineering problems.
2. Apply genetic algorithms to combinatorial optimization problems.
3. Learn the application of algorithms for engineering Optimization.

ECE106	Telecommunication Switching and Network	3-0-0	Credits 3

Course Objectives:

1. To introduce fundamental functions of a telecommunication switching systems, Electronic space division switching.

2. To introduce the concepts of space switching, time switching and combination switching.
3. To introduce a mathematical model for the analysis of telecommunication traffic.
4. To understand about various signaling in telecommunication systems.
5. To analyze various telecommunication networks.

MODULE-I **(10 Hours)**

Introduction

Evolution of Telecommunications, Simple Telephone Communication, Manual switching system, major telecommunication Networks, Strowger Switching System, Crossbar Switching.

Electronic space division switching

Stored Program Control, Centralized SPC, Distributed SPC, Enhanced Services, Two stage networks, Three stage network n-stage networks.

MODULE-II **(12 Hours)**

Time Division Switching

Basic time division space switching, time division time switching, time multiplexed space and time switching, combination switching, three-stage & n stage combination switching.

Traffic Engineering

Network traffic load and parameters, Grade of services & blocking probability, modeling of switching systems, incoming traffic & service time characterization, blocking models and loss estimates, Delay systems.

MODULE-III **(12 Hours)**

Telephone Networks

Subscriber Loop Systems, Switching Hierarchy and Routing, Transmission Plan, Transmission Systems, Numbering Plan, Charging Plan, Signaling Techniques, In channel signaling, common channel signaling, Cellular mobile telephony.

Data Networks

Data transmission in PSTN, switching techniques, Data communication architecture, ISO-OSI Reference Model, link-to-link layers, end-to-end layers, satellite based data networks, an overview of data network standards.

MODULE-IV **(08 Hours)**

Integrated Services Digital Networks

Motivation for ISDN, New services, Network and Protocol architecture, Transmission Channels, User Network Interface, signaling, Numbering and Addressing, Service characterization, Interworking , ISDN

standards, Broadband ISDN, Voice data Integration.

Text Books:

1. Thiagarajan Viswanathan, "Telecommunication Switching Systems and Networks", PHI, 2nd edition, 2010.
2. J. E. Flood, "Telecommunications Switching, Traffic and Networks", Pearson Education, 1st edition, 2002.

Reference Books:

1. A.L. Garcia and I. Widiaja, "Communication Networks", TMH, 2004.
2. Bellamy John, "Digital Telephony", John Wily & Sons, 3rd edition. 2000.

Course Outcomes:

1. Analysis of various telecommunication networks.
2. Estimate the performance of Telecommunication Networks.
3. Calculation of Blocking probability in multistage networks.
4. Describe integrated networks.
5. To compare telephone network, data network and integrated service digital network.

ECE107	Data Security and Cryptography	3-0-0	Credits 3

Course Objectives:

1. To know and understand the fundamentals of Cryptography.
2. To acquire knowledge on standard algorithms used to provide confidentiality, integrity and authenticity.
3. To understand the various key distribution and management schemes.
4. To understand how to deploy encryption techniques to secure data in transit across data networks.

MODULE-I **(12 Hours)**

Understanding of the data security and Cryptography algorithms

Security Goals, Attacks, Services and Mechanism, Techniques, Traditional Symmetric-Key Ciphers, Substitution Ciphers, Transposition Ciphers, Stream and Block Ciphers, Modern Symmetric-Key Ciphers, Modern Block Ciphers, Modern Stream Ciphers, Data Encryption Standard (DES), DES Structure, DES Analysis, Multiple DES, Security of DES, Differential Cryptanalysis, Linear Cryptanalysis of DES.

MODULE-II **(10 Hours)**

Advanced data security and authentication of message

Advanced Encryption Standard (AES), Transformations, Key Expansion, Analysis of AES, Message Integrity and Message Authentication, Message integrity, Random Oracle Model, Message authentication, Cryptographic Hash Functions, SHA-512, Whirlpool.

MODULE-III **(8 Hours)**

Entity authentication mechanism and key management

Entity Authentication, Passwords, Challenge response, Zero knowledge, Key Management, Symmetric-key Distribution, Kerberos, Symmetric key agreement, Public key distribution.

MODULE-IV **(12 Hours)**

Application layer and Network layer security with case study using VHDL

Security at application layer, E-mail, PGP, S/MIME, Security at the network layer, Two modes, two security protocols, security association, security policy, Internet key exchange, Case Study Using VHDL, Introduction to VHDL, Syntax and commands in VHDL, Design of Cryptography model to achieve data security.

Text Books:

1. Behrouz A. Forouzan, "Cryptography and Network Security", McGraw-Hill, 2007.
2. Douglas L. Perry, "VHDL Programming by Example", McGraw-Hill, 4th edition, 2002.

Reference Books:

1. Atul Kahate, "Cryptography & Network Security", McGraw-Hill, 2nd edition, 2007.

Course Outcomes:

1. Analyze the vulnerabilities in any computing system and hence be able to design a
2. security solution.
3. Identify the security issues in the network and resolve it.
4. Evaluate security mechanisms using rigorous theoretical approaches.
5. Design and implement the Cryptography model using VHDL.

ECE108	Fiber Optics Devices and Components	3-0-0	Credits 3

Course Objectives:

1. To expose the students to the basics of signal propagation through optical fibers, fiber impairments,

components and devices and system design.

2. Recognize and classify the structures of Optical fiber and types.
3. Classify the Optical sources and detectors and to discuss their principle.

MODULE-I **(10 Hours)**

Optical Fibers: Structures and Fabrication

Basic optical laws, Optical fiber modes and configurations, Mode theory of optical waveguides, single mode fibers, Graded indexed fibers, Fiber materials, Fiber fabrication, Mechanical properties of fiber, fiber optics cables, grating theory, application of diffraction grating, electro-optic effect.

MODULE-II **(10 Hours)**

Opto-Electronic Devices

Photo diode, PIN, photo-conductors, solar cells, phototransistors, materials used to fabricate LEDs and lasers design of LED for optical communication, response times of LEDs, Laser diodes, lasers classifications, lasers applications.

MODULE-III **(10 Hours)**

Optical Fiber Sensors

Active and passive optical fiber sensor, intensity modulated sensor, displacement type sensors, multimode active optical fiber sensor (micro bend sensor) single mode fiber sensor-phase modulates and polarization sensors.

MODULE-IV **(12 Hours**

Optical Amplifiers and Optical Components

Introduction to optical amplifiers, Semiconductor optical amplifiers, Erbium-doped fiber amplifiers, amplifier noise, optical SNR, wideband optical amplifiers, Overview of WDM, passive optical couplers, Isolators and circulators, fiber grating filters, Diffraction gratings, Active optical components.

Text Book:

1. G. Keiser, "Optical Fiber Communications", Tata McGraw Hill publications, 5th edition, 2014.
2. J. Wilson and J. B. Hawkes, "Opto-Electronics: An Introduction", Prentice Hall of India, 3rd edition, 2011.

Reference Book:

1. J. M. Senior, "Optical Fiber Communication-Principles and Practice", Prentice Hall of India, 1st edition, 1985.
2. G. P. Agrawal, "Fiber Optic Communication Systems", Wiley, 3rd edition, 2002.

Course Outcomes:

1. Recall basic laws of optical physics. Distinguish between the various modes of operation of optical fibers. Identify the various causes for signal degradation.
2. Understand the concept and working of different optoelectronic devices.
3. Provide adequate knowledge about the Industrial applications of optical fibers.
4. Discuss the channel impairments like losses and dispersion.

ECE109	Cognitive Radio System	3-0-0	Credits 3

Course Objectives:

1. To know the basics of Software Defined Radios and explore the principle of Cognitive Radio.
2. To learn the design of the wireless networks based on the cognitive radios.
3. To understand the concepts of wireless networks and next generation networks.
4. To discuss research challenges in Cognitive Radio Techniques.

MODULE-I **(12 Hours)**

Introduction to Software Defined Radio

The need for Software Radios& Definitions, Characteristics and Benefits of a Software Radio, Software Radio Architecture Evolution, Design Principles, Technology Tradeoffs and Architecture Implications.

SDR Architectur

Essential functions of software radio, Basics of SDR, Hardware Architecture, Computational Processing resources, Software Architecture, Top level component interfaces, Interface topologies among plug and play modules, SDR implementation issues.

MODULE-II **(12 Hours)**

SDR as Platform for Cognitive Radio

Introduction, Hardware and Software architecture, SDR development process and design, Application Software- Component Development.

Introduction to Cognitive Radios

SDR and application to cognitive radio networking, Overview of Cognitive Radio**,** Marking Radio self-aware, Cognitive Techniques**,** Position &Environment Awareness in Cognitive Radios, Optimization of Radio Resources.

MODULE-III **(10 Hours)**

Cognitive Radio Technology

Introduction, Radio flexibility and capability, Adaptability, Comparison of Radio compatibilities and properties, Available Technologies, IEEE 802 Cognitive Radio related activities, Applications.

Cognitive Radio Architecture

Cognitive Radio, Functions, Components and design rules, Cognitive cycle- Orient, Plan, Decide and act phases, Inference Hierarchy, Architecture maps, Building the Cognitive Radio Architecture on Software Defined Architecture.

MODULE-IV **(8 Hours)**

Next Generation Wireless Networks

The XG Network Architecture, Spectrum Sensing, Spectrum Management, Spectrum Mobility, Spectrum Sharing, Upper layer issues, Cross-layer Design.

Technical Challenges

Design challenges associated with Cognitive Radio, Hardware requirements, Hidden primary user problem, detecting spread spectrum primary users, Sensing duration and frequency, Security issues.

Text Books:

1. Jeffrey H. Reed, "Software Radio: A modern approach to Radio Engineering", Prentice Hall PTR, 2002.
2. Joseph Mitola, "Software Radio Architecture: Object Oriented Approaches to wireless System Engineering", Wiley-Interscience, 1st edition, 2000.

Reference Books:

1. Bruce A Fette, "Cognitive Radio Technology", Academic Press, 2009.
2. Huseyin Arslan, "Cognitive Radio, Software Defined radio and Adaptive Wireless system", Springer, 1st edition, 2007.
3. M. Dillinger, K. Madani, N. Alonistioti, "Software Defined Radio: Architectures, Systems and Functions", John Wiley & Sons, 2005.

Course Outcomes:

1. Describe the basics of the Software defined Radios.
2. Design the wireless Networks Based on the Cognitive Radios.
3. Explain the Concepts behind the wireless Networks and Next generation Networks.
4. Design and operate Software Defined Radio systems.

ECE110	VLSI for Wireless Communication	3-0-0	Credits 3

Course Objectives:

1. To study the different electronics circuits such as mixer, filter and amplifier circuits used in the transmission and reception of signal through Wireless medium.
2. To learn about the channels used for the Wireless Communication.
3. To analyze the synthesizer circuits used in the Wireless Communication Systems.

MODULE-I **(10 Hours)**

Overview of wireless communication and architecture

Communication Concepts in terms circuit designer perspective, Classical Channel, Path loss, Multipath fading (channel model), Receiver Architectures, Receiver front end, Filter design, Noise and Noise sources.

MODULE-II **(10 Hours)**

Study and Design of LNA and mixer circuits

Low Noise Amplifier, Wideband LNA design, Narrowband LNA (Impedance matching and Core Amplifier), Active Mixer, balancing, Qualitative description of Gilbert Mixer, Conversion Gain, Distortion (Low frequency and high frequency case).

MODULE-III **(10 Hours)**

Study and Design of Passive Mixer

Passive Mixer, Switching Mixer, Distortion, Conversion Gain and Noise in Unbalanced Switching Mixer, A practical Unbalanced Switching Mixer, Sampling Mixer, Conversion Gain, Distortion.

MODULE-IV **(12 Hours)**

Analysis of Synthesizer circuits

Frequency Synthesizer, Processing Components, PLL based Frequency Synthesizer, Phase Detector, Dividers, VCO, LCO, Phase noise Frequency Synthesizer, Loop Filter and System Design Introduction, Loop Filter (General description and design approaches).

Text Books:

1. Bosco Leung, "VLSI for Wireless Communication", Prentice Hall Electronics and VLSI series, 2002.
2. B. Razavi, "RF Microelectronics", Prentice Hall, 1998.

Reference Books:

1. Behzad Razavi, "Design of Analog CMOS Integrated Circuits", McGraw-Hill, 1999.
2. Thomas H.Lee, "The Design of CMOS Radio –Frequency Integrated Circuits", Cambridge University Press, 2003.

Course Outcomes:

1. Design and simulate the different Electronics circuits required for the Wireless Communication System.
2. Analyze the noise associated with the transmission and reception of the signal through Wireless channel.

ECE111	Satellite Communication System	3-0-0	Credits 3

Course Objectives:

1. To understand the basic concept in the field of Satellite Communication and to place a satellite in an orbit.
2. To calculate the link power budget.
3. To get a complete knowledge about the earth and space subsystems.
4. To gain knowledge about the Satellite Access schemes.
5. To gain knowledge about the Satellite system and mobile services provided.

MODULE-I **(13 Hours)**

Introduction to satellite communication

Communication satellites; orbits and description, orbital period and velocity, azimuth and orbital inclination, coverage angle and slant range, eclipse, placement of satellite in geostationary orbit. Communication Engineering Satellite Description: Communication subsystem, Telemetry, command and ranging subsystem, altitude control subsystem, electrical power subsystem. Earth station: earth station antenna type, gain, pointing loss. Antenna gain to noise temperature variation G/T. G/T measurements. Spurious effect of frequency conversion. Satellite transponder: Transponder model, transponder channelization, frequency plans and processing transponders.

MODULE-II **(12 Hours)**

Satellite link

Basic link analysis, interference analysis, Rain induced attenuation, satellite link design, link with frequency reuse and link without frequency reuse, satellite multiple access system. Frequency Division Multiple Access: Principle, SPADE, FDM-FM-FDMA, Companded FDM-FMFDMA and SSB-AM-FDMA, Intermodulation products in FDMA, optimized carrier-to-intermodulation plus noise ration.

MODULE-III **(09 Hours)**

Time Division Multiple Access

Principle, TDMA frame structure, TDMA burst structure, TDMA super frame structure, frame acquisition and synchronization. Satellite position determination, TDMA timing. Demand Assignment Multiple Access and

digital speech interpolation. Erlang B formula. Type of demand assignment, DAMA characteristics, real time frame reconfiguration, DAMA interfaces, SCPC- DAMA, digital speech interpolation. Satellite packet communication.

MODULE-IV **(08 Hours)**

Very Small Aperture Terminal Network (VSAT)

VSAT technologies, Network configurations, Multi access and networking, Network error control polling VSAT network, Mobile Satellite Network (MSAT)-Operating environment, MSAT network concept, CDMA MSAT relink.

Text Books:

1. T. Pratt and C. W. Bostier,"Satellite Communication", John Wiley & Sons, 2nd edition, 2006.
2. D.C. Agrawal and A. K. Malini, "Satellite Communication", Khanna, 1991.

Reference Books:

1. Wilbur L.Pritchard, Hendri G. Suyderhoud, Robert A. Nelson, "Satellite Communication Systems Engineering", Prentice Hall, 2007.
2. N. Agarwal, "Design of Geosynchronous Space Craft", Prentice Hall, 1986.
3. Bruce R. Elbert, "The Satellite Communication Applications", Hand Book, Artech House, 1997.
4. Tri T. Ha, "Digital Satellite Communication", Mcgraw Higher Education, 2nd edition, 1990.

Course Outcomes:

1. Understand orbital mechanics and launching methodologies.
2. Understand satellite subsystems and link power budget for satellites.
3. Compare competitive satellite services and understand satellite access techniques.

ECE112	Wireless Sensor Network	3-0-0	Credits 3

Course Objectives:

1. To apply knowledge of wireless sensor networks (WSN) to various application areas.
2. To design and implement WSN.
3. To formulate and solve problems creatively in the areas of WSN and IoT.

MODULE-I **(10 Hours)**

Introduction to Wireless Sensor Networks

WSN Architecture and Protocol Stack, Applications of WSN, Factors Influencing WSN Design: Hardware Constraints, Fault Tolerance, Scalability, Production Costs, WSN Topology, Transmission Media, Power Consumption, Wireless channel effects.

MODULE-II **(12 Hours)**

Medium Access Control

Challenges for MAC, CSMA Mechanism, Contention-Based Medium Access: S-MAC, B-MAC, CC-MAC, Reservation-Based Medium Access.

Error control

Classification of Error Control Schemes, Error Control in WSNs, Cross-layer Analysis Model, Comparison of Error Control Schemes: Hop Length Extension and Transmit Power Control.

MODULE-III **(10 Hours)**

Sensor Localization and Tracking

Canonical problem of Localization and tracking: A tracking scenario, problem formulation, Bayesian state estimation, Tracking multiple objects: state space decomposition, Data association, sensor models, Performance Comparison and Metrics.

MODULE-IV **(10 Hours)**

Sensor tasking and Control

Task-Driven Sensing, Information-Based Sensor Tasking, Joint Routing and Information Aggregation, Sensor network data base: Sensor Database Challenges, Querying the Physical Environment, Query Interfaces, High-Level Database Organization, In-Network Aggregation, Data-Centric Storage.

Text Books:

1. I. F. Akyildiz and M. C. Vuran, "Wireless Sensor Networks", John Wiley and Sons, 2010.
2. Feng Zhao & Leonidas J. Guibas, "Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007.

Reference Books:

1. Bhaskar Krishnamachari, "Networking Wireless Sensors", Cambridge Press, 2005.
2. Mohammad Ilyas and Imad Mahgaob, "Handbook of Sensor Networks: Compact Wireless and Wired Sensing Systems", CRC Press, 2005.

Course Outcomes:

1. Understand the fundamentals and basic features of wireless sensor networking.
2. Able to identify, formulate, and solve engineering problems of wireless sensor networks.
3. To use the techniques, skills, and modern engineering tools necessary for engineering practice.

ECE113	Security in Wireless and Mobile Communication	3-0-0	Credits 3

Course Objectives:

1. Overview of mobile architecture and security.
2. Familiarize with the concept of Wireless Network Security.
3. Comprehensive knowledge on Ad hoc Network Security.
4. To learn and understand RFID Security.

MODULE-I **(10 Hours)**

Mobile Security

Mobile system architectures, Overview of mobile cellular systems, GSM and UMTS Security & Attacks, Vulnerabilities in Cellular Services, Cellular Jamming Attacks & Mitigation, Security in Cellular VoIP Services, Mobile application security.

MODULE-II **(10 Hours)**

Wireless Network Security

Overview of Wireless security, Scanning and Enumerating 802.11 Networks, Attacking 802.11 Networks, Attacking WPA protected 802.11 Networks, Bluetooth Scanning and Reconnaissance, Bluetooth Eavesdropping, Attacking and Exploiting Bluetooth, Zigbee Attacks, Zigbee Security.

MODULE-III **(10 Hours)**

Adhoc Network Security

Security in Ad Hoc Wireless Networks, Network Security Requirements, Issues and Challenges in Security Provisioning, Network Security Attacks, Key Management in Adhoc Wireless Networks, Secure Routing in Adhoc Wireless Networks.

MODULE-IV **(12 Hours)**

RFID Security

Introduction, RFID Security and privacy, RFID chips Techniques and Protocols, Man-in-the-middle attacks on RFID systems, Combining Physics and Cryptography to Enhance Privacy in RFID Systems, An Efficient and Secure RFID Security Method with Ownership Transfer, Policy-based Dynamic Privacy Protection Framework leveraging Globally Mobile RFIDs, User-Centric Security for RFID based Distributed Systems.

Text Books:

1. S. Kami Makki, Peter Reiher, Kia Makki, "Mobile and Wireless Network Security and Privacy", Springer, 2007.
2. C. Siva Ram Murthy, B. S. Manoj, "Ad Hoc Wireless Networks Architectures and Protocols", Prentice Hall, 2007.

3. Paris Kitsos, Yan Zhang, "RFID Security Techniques, Protocols and System-On-Chip Design", Springer, 2008.

Reference Book:

1. Noureddine Boudriga, "Security of Mobile Communications", Auerbach Publications, 2010.

Course Outcomes:

1. Understanding mobile architecture and security.
2. Acquiring ideas on wireless Network Security
3. Gaining knowledge on Ad hoc Network Security**.**
4. In depth understanding the concept of RFID Security.

ECE114	Antenna Theory and Design	3-0-0	Credits 3

Course Objectives:

1. To understand the fundamentals and different characteristics of antenna.
2. To provide comprehensive knowledge about different antennas.
3. To learn and understand antenna array design and feeding techniques.
4. Familiarize with the concept of antenna synthesis and different computational electromagnetic methods for antenna design.

MODULE-I **(7 Hours)**

Antenna fundamentals and definitions

Radiation mechanism- overview, EM fundamentals, Solution of Maxwell's equations for radiation problems, Ideal dipole, Radiation patterns, Directivity and gain, Antenna impedance, Radiation efficiency, Antenna polarization.

MODULE-II **(10 Hours)**

Resonant Antennas

Wired and patch antenna, Dipole antenna, Yagi-Uda antenna, Microstrip antenna.

Arrays

Array factor for linear arrays, Uniformly excited equally spaced linear arrays, Pattern multiplication, Directivity of linear arrays, Non-uniformly excited equally spaced linear arrays, Mutual coupling, Multidimensional arrays, Phased arrays, Feeding techniques, Perspectives on Arrays.

MODULE-III **(11 Hours)**

Broadband antennas

Travelling wave antennas, Helical antennas, Bi-conical antennas, Principles of frequency independent antennas, Spiral antennas, and Log – periodic antennas.

Reflector antennas

Parabolic reflector antenna principles, Axi-symmetric parabolic reflector antenna, Offset parabolic reflectors, Dual reflector antennas, Gain calculations for reflector antennas, Feed antennas for reflectors, Matching the feed to the reflector, General feed model, Feed antennas used in practice.

MODULE-IV **(14 Hours)**

Antenna Synthesis

Formulation of the synthesis problem, Synthesis principles, Line sources shaped beam synthesis, Linear array shaped beam synthesis, Fourier series, Woodward - Lawson sampling method, Comparison of shaped beam synthesis methods, low side lobe narrow main beam synthesis methods, Dolph-Chebyshev linear array, Taylor line source method.

Method of moments

Introduction to the method of moments, Pocklington's integral equation, Integral equation and Kirchhoff's networking equations, Source modeling weighted residual formulations and computational consideration, Calculation of antenna and scatter characteristics.

Text Books:

1. C. A. Balanis, "Antenna Theory Analysis and Design", John Wiley, 4th edition, 2016.
2. Warren L.Stutzman, Gary A.Thiele, "Antenna theory and design", John Wiley and sons, 3rd edition, 2012.
3. J. D. Kraus, "Antennas", McGraw Hill TMH, 3rd edition, 2001.

Reference Book:

1. A. R Harish, M. Sachidnanda, "Antennas and wave propagation", Oxford University Press, 2007.

Course Outcomes:

1. Understanding different fundamental parameters of antenna.
2. Developing the basic skills necessary for designing a wide variety of practical antennas and antenna arrays.
3. Acquiring computational knowledge of antenna synthesis and method of moments.

ECE115	Optical Wireless Communication	3-0-0	Credits 3

Course Objectives:

1. Vision and Introduction to wireless optical communication system.
2. Learn the difference between FSO and radio frequency communication system.
3. Learn different applications of FSO.
4. Understand different types of atmospheric losses, and atmospheric turbulences in FSO.
5. Learn FSO channel modelling.
6. Learn Performance improvement of FSO using different diversity and channel coding techniques.

MODULE-I **(08 Hours)**

Overview of wireless optical communication system

Wireless optical communication system: An Overview, Indoor wireless optical communication system, Types of link configurations, Comparison of FSO and radio frequency communication system, Choice of wavelength in FSO communication system, Technologies used in FSO,

Coherent detection, Optical orthogonal frequency division multiplexing, Applications of FSO communication system.

MODULE-II **(12 Hours)**

Free space optical channel models

Atmospheric channel, Atmospheric losses, Atmospheric turbulence, Atmospheric turbulent channel model, Techniques for turbulence mitigation.

FSO system modules and design issues

Optical transmitters, Optical receivers, Optical modulators, Optical post and preamplifiers and Link design trade-off.

MODULE-III **(10 Hours)**

BER performance of FSO system

System model, BER Evaluation, Coherent subcarrier modulation schemes, Non-coherent modulation schemes (On-Off keying, M-ary Pulse position modulation, Differential PPM, Differential amplitude pulse position modulation).

MODULE-IV **(12 Hours)**

Link performance Improvement Techniques

Aperture averaging, Aperture averaging factor, Aperture averaging experiment, Types of Diversity

Techniques, Diversity combining techniques, BER performance with Diversity technique, Coding, Channel Capacity Channel coding in FSO system, Relay assisted FSO transmission.

Text Books:

1. Hemani Kaushal, V.K Jain, Subrat Kar, "Free Space Optical Communication", Springer, 2017.
2. Devi Chadha, "Terrestrial Wireless Optical Communication", Mc-Graw Hill Education, 2013.

Reference Books:

1. Olivier Bouchet, "Wireless Optical Communication", Wiley, 2013.
2. Z. Ghassemlooy, W. Popoola, S. Rajbhandari "Optical Wireless Communications: System & Channel Modelling with MATLAB", CRC Press, Taylor and Francis Group, 2017.

Course Outcomes:

1. Understand wireless optical communication system.
2. Determine the advantages and market perspective of FSO.
3. Use of transmitters, modulators, receivers and amplifiers in FSO.
4. Use of different diversity techniques to improve the BER performance of FSO communication system
5. Industrial applications of FSO communication system.

ECE116	Mathematics for Communication Engineers	3-0-0	Credits 3

Course Objectives:

1. To understand the basics and applications of linear algebra towards communication and signal processing.
2. Knowledge of principles of random variables and processes.
3. To understand various aspects of wireless communication systems using the concepts of probability and random variables as well as random processes.
4. To understand several components of wireless systems such as the average transmit power, bit-error rate and behavior of the fading channel coefficients.

MODULE-I **(12 Hours)**

Vector Spaces and Linear Algebra

Vector spaces: Liner combination of vectors, Linear independence, Basis and dimension, Norms and normed vector spaces, Inner product and Inner product spaces, Weighted inner products, Induced norms, Direction of Vectors: Orthoganality, orthogonal subspaces, Linear transformations: Range and Null spaces, projections and orthogonal projections, Projection theorem.

MODULE-II **(10 Hours)**

Linear operators and Matrices

Linear operators, Operator norms, Geometry of linear equations, properties of matrix inversion, Pseudo inverses, Eigen values and Eigen vectors: Linear dependence of Eigen vectors, computation of Eigen values and Eigen vectors, Diagonalization of a matrix, Signal subspace techniques: the signal model, the noise model.

MODULE-III **(10 Hours)**

Matrix Factorization

The LU factorization: Computing the determinant using the LU factorization, Computing the LU factorization, The Cholesky factorization, Unitary matrices and the QR factorization: Unitary matrices, The Singular Value Decomposition.

MODULE-II **(10 Hours)**

Probability Theory and Random Process for Communication

Basics of probability, Conditional probability, Total probability, Random Variables, Probability density functions, Basics of Random Process, Wireless channel fading modeling, Gaussian random process, Calculation of Probability of error.

Text book:

1. T. K. Moon and W.C. Stirling, "Mathematical Methods and Algorithms for Signal Processing", Pearson Education, 2000.
2. A. Papoulis and S. U. Pillai, "Probability random variables and stochastic process, TMH, 4th edition, 2001.

Reference Book:

1. G. Strang, "Linear Algebra and its Applications", Cengage Learning, 3rd edition, 2014.
2. P. Z. Peebles, "Probability, Random Variables and Random Signal principles", Tata McGraw-Hill, 4th edition, 2002.

Course Objective:

1. Understand the formulation of problems in abstract algebra framework and vector analysis of signals.
2. Understand and represent linear transformations.
3. Understand the role of matrices in linear transformation representations.

ECE117	Multimedia Communication	3-0-0	Credits 3

Course Objectives:

1. Understanding the basic need of multimedia and component of multimedia.
2. To understand encoding and decoding of digital data streams.
3. To introduce methods for the generation of these codes and their decoding techniques.
4. To have a detailed knowledge of compression and decompression techniques.

MODULE-I **(09 Hours)**

Multimedia Information Representation

Text, Unformatted text, Formatted text, Hypertext, Images, Graphics, Digitized documents, Digitized pictures, Audio, PCM speech, CD quality audio, Synthesized audio, Video, Broadcast television, Digital video, Video content.

MODULE-II **(12 Hours)**

Multimedia Communications

Human Communication Model, PhysicalSystem, Symbol Encoding, Feeling, Memory, Cognitive System, Evolution and convergence, Technology Framework, Multimedia, Technologies, Multimedia Networking, Multimedia Conferencing, Multicasting, Technologies for e-Content. Standardization Framework, Research and Regulation, Technology and Education, Convergence and Regulatory Issues, Manufacturing and Marketing.

MODULE-III **(09 Hours)**

Frameworks for Multimedia Standardization

Standardization Activities**,** Standards to Build a New Global Information Infrastructure (GII), Standardization Processes on Multimedia Communications, ITU-T Mediacom 2004 Framework for Multimedia Communications, ISO/IEC MPEG-21 Multimedia Framework IETF Multimedia Internet Standards.

MODULE-IV **(12 Hours)**

Applications Layer – MPEG, JPEG

MPEG Applications, JPEG Application, Digital TV and Storage Media, Multimedia Conferencing, Streaming Media, and Interactive Broadcasting, Media Description, Searching and Retrieval, Media Distribution and Consumption. Media Streaming, MPEG-4 Delivery Framework, Streaming Video over the Internet, Broadband Access, Quality of Service, Framework.

Text Books:

1. K. R. Rao, Zoran S. Bojkovic and Dragorad A. Milovanovic, "Introduction to Multimedia Communications: Applications, Middleware, Networking", Wiley Interscience, 1st edition, 2006.
2. Fred Halsall, "Multimedia Communications: Applications, Networks, Protocols and Standards," Pearson education, 4th edition, 2009.

Reference Books:

1. Chen Chang Wen, Li, Zhu, Lian, Shiguo, "Intelligent Multimedia Communication: Techniques and Applications", Springer-Verlag, 2010.
2. John William Woods, "Multidimensional Signal, Image and Video Processing and Coding", Academic Press, 2nd edition, 2012.
3. R. Steimnetz, K. Nahrstedt, "Multimedia Computing, Communications and Applications", Pearson Education, 2004.
4. Ranjan Parekh, "Principles of Multimedia", TMH, 2007.

Course Outcomes:

1. To understand the multimedia communication and to know how communication and computing technologies bring new user interface.
2. To understand the various multimedia standards and their applications.
3. Apply the compression concepts in multimedia communication.

ECE118	Embedded System Design	3-0-0	Credits 3

Course Objectives:

1. Understand the basics of embedded system development tools Atmel RISC Processors.
2. Write C programs for Microcontrollers.
3. Familiarize with the concepts of IDE and AVR families.
4. Fundamentals of Ardunio Uno and application.

MODULE-I **(10 Hours)**

ATMEL RISC Processors and Development Tools

Introduction, Basics of developing for embedded systems, embedded system Initialization Atmel RISC Processors Architecture, Memory, Reset and interrupt functions Parallel I/O ports, Timer/Counters, Serial communication using UART, SPI, Analog Interfaces, AVR RISC Assembly language instruction set.

MODULE-II **(10 Hours)**

Elements of C Programming and Preprocessor Functions

Variables and constants, I/O operations, Operators andExpressions, Control statements, Functions, Pointers and Arrays, Structure and Unions, Memory types, Real time methods, Standard I/O and Preprocessor functions.

MODULE-III **(10 Hours)**

IDE and Project Development

Code Vision AVR C Compiler and IDE: IDE**,** Operation, C Compiler Options, Compile and Make Projects, Program the target device, AVR code generator, Atmel AVR Studio debugger, Project development: Process steps.

MODULE-IV **(10 Hours)**

Introduction to Ardunio Uno

Introduction to Ardunio Platform, Block Digram, Architecture, Pin Configuration, Introduction to Arduino IDE, Writing, Saving, Compiling and Uploading Sketches, Interfacing discrete LEDs, Binary Counter, Seven Segment LEDs, Interfacing with Different type of Sensors and Communication MODULE-s.

Text Books

1. Qing Li with Caroline Yao, "Real-Time Concepts for Embedded Systems", CMP, 2011.
2. Barnett, Cox, and O'Cull "Embedded C Programming and the Atmel AVR" Thomson Delmar learning, 2006.
3. Simon Monk, "Programming Arduino", Mc Graw Hill Eduction, 2nd edition, 2012.

Reference Books

1. Jeremy Blum, "Exploring Arduino", Willy, 1st edition, 2013.
2. Steven F. Barrett, "Embedded System Design with the Atmel AVR Microcontroller", Morgan & Claypool, 2009.

Course Outcomes:

1. Understand the fundamentals of embedded system development tools Atmel RISC Processors.
2. Able to write C programs for Microcontrollers for small projects.
3. Understand the concepts of IDE and AVR families.
4. Able to make small projects on Ardunio Uno and application.

ECE119	MIMO Communication System	3-0-0	Credits 3

Course objectives:

1. To learn about basic MIMO communication systems.
2. To provide a comprehensive coverage of coding techniques for multiple input.
3. Compare MIMO Systems with Single Input Single Output (SISO) Systems.

4. Knowledge on MIMO systems for frequency-selective (FS) fading channels.
5. To study space-time block codes, Space-time trellis codes, Turbo codes and iterative decoding for MIMO systems.

MODULE-I **(12 Hours)**

Overview on MIMO and Fading Channels

Wireless channels, Introduction to Multi-antenna Systems, Multiple antennas in wireless communications, types of multi-antenna systems, MIMO vs. multi-antenna systems, Error/Outage probability over fading channels, MIMO frequency-selective channels.

MIMO Diversity and Spatial Multiplexing

Diversity techniques, Sources and types of diversity, analysis under Rayleigh fading, Diversity and channel knowledge, exploiting multipath diversity. MIMO spatial multiplexing, BLAST receivers and Diversity multiplexing trade-off.

MODULE-II **(10 Hours)**

Capacity and Information Theoretic aspects of MIMO channels

Review of SISO fading communication channels, MIMO channel models, Frequency selective and correlated channel models, Capacity of MIMO channels, Capacity of non-coherent MIMO channels, Ergodic and outage capacity, Capacity bounds and influence of channel properties on the capacity.

MODULE-III **(10 hours)**

Space Time Block Codes

Transmit diversity with two antennas, Space time block codes on real and complex orthogonal designs, Code design criteria for quasi-static channels (Rank, determinant and Euclidean distance), Orthogonal designs, Generalized orthogonal designs, Quasi-orthogonal designs and Performance analysis.

MODULE-IV **(10 Hours)**

Space Time Trellis Codes

Representation of STTC, shift register, generator matrix, state-transition diagram, trellis diagram, Code construction, Delay diversity as a special case of STTC and Performance analysis.

Text Books:

1. David Tse and PramodViswanath, "Fundamentals of Wireless Communication", Cambridge University Press, 2005.
2. Tolga M. Duman and Ali Ghrayeb, *"*Coding for MIMO Communication systems*",* John Wiley & Sons, 2007.
3. Ezio Biglieri, Robert Calderbank, "MIMO Wireless Communications" Cambridge University Press,

2007.

Reference Books:

1. E.G. Larsson and P. Stoica, "Space-Time Block Coding for Wireless Communications", Cambridge University Press, 2008.
2. Hamid Jafarkhani, "Space-Time Coding: Theory and Practice", Cambridge University Press, 2005.

Course outcomes:

1. Compare MIMO Systems with Single Input Single Output (SISO) Systems.
2. Analyze the Information Theoretic advantages of MIMO Systems.
3. Introducing and analysis of space time codes.
4. Analyze the spatial multiplexing properties of MIMO.
5. Prove the existence of some space time codes.

ECE120	Remote Sensing and Advanced Techniques	3-0-0	Credits 3

Course Objectives:

1. To provide exposure to students in gaining knowledge on concepts and applications leading to modeling of earth resources management using Remote Sensing.
2. To acquire skills in storing, managing digital data for planning and development.

MODULE-I **(10 Hours)**

Introduction and Basic Concepts of Remote sensing

Introduction, Basic concepts of remote sensing, Airborne and space born sensors, Passive and active remote sensing, Energy interactions in the atmosphere, Energy interactions with earth surface features, Spectral reflectance curves.

MODULE-II **(10 Hours)**

Remote sensing systems

Satellites and orbits, Polar orbiting satellites, Spectral, radiometric and spatial resolutions, Temporal resolution of satellites, Multispectral, thermal and hyperspectral sensing, Some remote sensing satellites and their features.

MODULE-III **(10 Hours)**

Digital Image Processing - Image Restoration

Geometric corrections, Co-registration of Data, Ground Control Points (GCP), Atmospheric corrections, Solar

illumination corrections, Concept of color, Color composites, Filtering techniques, Edge enhancement, Density slicing, Thresholding, Intensity-Hue-Saturation (IHS) images, Time composite images, Synergetic images.

MODULE-IV **(12 Hours)**

Remote Sensing Applications and

Watershed management, Rainfall-runoff modeling, Irrigation management, Environmental monitoring.

Advanced Topics

Microwave remote sensing, sources of microwave data, Global positioning System (GPS), GPS for ground truth collection.

Text Books:

1. T.M. Lillesand and R.W. Kiefer, "Remote Sensing and Image Interpretation", John Wiley & Sons, 2002.
2. J.B. Cambell, "Introduction to Remote Sensing", Taylor & Francis, UK, 2002.

Reference Books:

1. F.F. Sabins "Remote Sensing - Principles and Interpretation", W.H. Freeman & Co, 1986.
2. R.A. Schowengerdt, "Remote Sensing - Models and Methods for Image Processing", Elsevier, 2006.

Course Outcomes:

1. Fully equipped with concepts, methodologies and applications of Remote Sensing Technology.
2. Acquire skills in handling instruments, tools, techniques and modeling while using Remote Sensing Technology

ECC103	Advance Communication and Network Lab	0-0-4	Credits 2

Experiment List

1. Design a FM receiver using Software Defined Radio kit.
2. Design a transmitter model with Software Defined Radio starter kit.
3. Design a voice transmitter and receiver model to transmit and receive voice signal using SDR starter kit.
4. Transmission and reception of a text file with SDR starter kit by using FSK modulation and demodulation technique.
5. Design a GSM receiver with SDR starter kit and observe the output on a spectrum analyzer.

6. Measurement of wavelength and voltage standing wave ratio by using Reflex Klystron.
7. Study of directional couplers to measure insertion loss, coupling and directivity.
8. Find out the Numerical Aperture and V number estimation of the single mode optical fiber.
9. Determine the insertion loss and loss uniformity of each channel of a WDM multiplexer.
10. Determine the optical cross talk in adjacent channels of WDM demultiplexer for various wavelengths.

ECC104	Design and Simulation Lab I	0-0-4	Credits 2

Experiment List

1. Simulation to realize the OFDM transmission system (without fading and with fading), BER, CCDF and PAPR analysis.
2. Simulation to realize various coding schemes for wireless communication system and their performance analysis.
3. Design and simulation of Rectangular patch antenna.
4. Design and simulation of Dipole antenna.
5. Design and simulation of Slot antenna.
6. Write a program to detect a target in clutter with low SNR.
7. Write a program to detect multiple targets in low probability of detection and low SNR.
8. Simulate an energy consumption model by incorporating MIMO techniques in a wireless sensor network.
9. Investigate the characteristics of PIN and Avalanche photodiodes.
10. Characterize analytically and through simulation the effects of dispersion on optical systems.

ECC203	Wireless Sensor Networking Lab	0-0-4	Credits 2

Experiment List

1. Design of IoT based home automation system (Prototype).
2. Design of IoT based home security system (Prototype).
3. Design of IoT based water level monitoring system (Prototype).
4. Design of IoT based motor speed control (Prototype).
5. Design of IoT based smart irrigation system (Prototype).
6. Component identification and set up to develop a wireless sensor network.
7. Configure a wireless sensor network to measure atmospheric temperature, humidity, pressure using different sensors.
8. Design and interfacing Robot with light follower and line follower.
9. Design and interfacing Robot with Zig-Bee communication.

ECC204	Design and Simulation Lab II	0-0-4	Credits 2

Experiment List

1. Simulation to realize the OFDM transmission system (without fading and with fading), BER, CCDF and PAPR analysis.
2. Simulation to realize various coding schemes for wireless communication system and their performance analysis.
3. Design and simulation of Rectangular patch antenna.
4. Design and simulation of Dipole antenna.
5. Design and simulation of Slot antenna.
6. Write a program to detect a target in clutter with low SNR.
7. Write a program to detect multiple targets in low probability of detection and low SNR.
8. Simulate an energy consumption model by incorporating MIMO techniques in a wireless sensor network.
9. Investigate the characteristics of PIN and Avalanche photodiodes.
10. Characterize analytically and through simulation the effects of dispersion on optical systems.

GHM101	Research Methodology & Intellectual Property Rights	2-0-0	Credits 2

MODULE-I **(06 Hours)**

Meaning of research problem, Sources of research problem, Criteria characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.

Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

MODULE-II **(04 Hours)**

Effective literature studies approaches, analysis,

Plagiarism, Research ethics.

MODULE-III **(04 Hours)**

Effective technical writing, how to write report, Paper.

Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

MODULE-IV **(06 Hours)**

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

MODULE-V **(04 Hours)**

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

MODULE-VI **(04 Hours)**

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Text/Reference Books:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science& engineering students'".
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.

5. Mayall, “Industrial Design”, McGraw Hill, 1992.
6. Niebel, “Product Design”, McGraw Hill, 1974.
7. Asimov, “Introduction to Design”, Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “Intellectual Property in New Technological Age”, 2016.
9. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008

Course Outcomes: At the end of the course, students will be able to

1. Understand research problem formulation.
2. Analyze research related information
3. Follow research ethics
4. Understand that today’s world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property.

   Right to be promoted among students in general & engineering in particular.
6. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Audit Courses

AHM101	English for Research Paper Writing	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Understand that how to improve your writing skills and level of readability
2. Learn about what to write in each section
3. Understand the skills needed when writing a Title

   Ensure the good quality of paper at very first-time submission

MODULE-I **(4 Hours)**

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

MODULE-II **(4 Hours)**

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction.

MODULE-III **(4 Hours)**

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

MODULE-IV **(4 Hours)**

key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed whenwriting a Review of the Literature.

MODULE-V **(4 Hours)**

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions.

MODULE-VI **(4 Hours)**

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

Suggested Studies:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book.

4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

ACE101	Disaster Management	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

MODULE-I **(4 Hours)**

Introduction

Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

MODULE-II **(4 Hours)**

Repercussions of Disasters and Hazards:

Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem.

Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

MODULE-III **(4 Hours)**

Disaster Prone Areas In India

Study of Seismic Zones; Areas Prone To Floods And Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics

MODULE-IV **(4 Hours)**

Disaster Preparedness and Management

Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data From Meteorological and Other Agencies, Media Reports: Governmental and

Community Preparedness.

MODULE-V **(4 Hours)**

Risk Assessment

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategiesfor Survival.

MODULE-VI **(4 Hours)**

Disaster Mitigation

Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation In India.

Text / Reference Books:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies, NewRoyal book Company.
2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall OfIndia, New Delhi.
3. Goel S. L., Disaster Administration And Management Text And Case Studies" ,Deep &Deep Publication Pvt. Ltd., New Delhi.

AHM102	Sanskrit for Technical Knowledge	2-0-0	Credits 0

Course Objectives:

1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. Learning of Sanskrit to improve brain functioning
3. Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power
4. The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature

MODULE-I **(8 Hours)**

- Alphabets in Sanskrit
- Past/Present/Future Tense
- Simple Sentences

MODULE-II **(8 Hours)**

- Order
- Introduction of roots
- Technical information about Sanskrit Literature

MODULE-III **(8 Hours)**

- Technical concepts of Engineering-Electrical, Mechanical,Architecture, Mathematics

Suggested reading:

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

Course Output: Students will be able to

1. Understanding basic Sanskrit language
2. Ancient Sanskrit literature about science & technology can be understood
3. Being a logical language will help to develop logic in students

AHM103	Value Education	2-0-0	Credits 0

Course Objectives: Students will be able to

1. Understand value of education and self- development
2. Imbibe good values in students
3. Know about the importance of character

MODULE-I **(6 Hours)**

- Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism.
- Moral and non- moral valuation. Standards and principles.
- Value judgements

MODULE-II **(6 Hours)**

- Importance of cultivation of values.
- Sense of duty.Devotion, Self-reliance.Confidence, Concentration. Truthfulness, Cleanliness.
- Honesty, Humanity.Power of faith, National Unity.
- Patriotism.Love for nature, Discipline

MODULE-III **(6 Hours)**

- Personality and Behavior Development - Soul and Scientific attitude.
- Positive Thinking. Integrity and discipline.
- Punctuality, Love and Kindness.
- Avoid fault Thinking.
- Free from anger, Dignity of labour.
- Universal brotherhood and religious tolerance.
- True friendship.
- Happiness Vs suffering, love for truth.
- Aware of self-destructive habits.
- Association and Cooperation.
- Doing best for saving nature

MODULE-IV **(6 Hours)**

- Character and Competence –Holy books vs Blind faith.
- Self-management and Good health.
- Science of reincarnation.
- Equality, Nonviolence, Humility, Role of Women.
- All religions and same message.
- Mind your Mind, Self-control.
- Honesty, Studying effectively

Text / Reference Books

1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

Course outcomes: Students will be able to

1. Knowledge of self-development

2. Learn the importance of Human values
3. Developing the overall personality

AHM104	Constitution of India	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutionalrole and entitlement to civil and economic rights as well as the emergence of nationhood inthe early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the BolshevikRevolution in 1917 and its impact on the initial drafting of the Indian Constitution.

MODULE-I **(4 Hours)**

- **History of Making of the Indian Constitution:**

  History

  Drafting Committee, (Composition& Working)

MODULE-II **(4 Hours)**

- **Philosophy of the Indian Constitution:**

  Preamble

  Salient Features

MODULE-III **(4 Hours)**

- **Contours of Constitutional Rights & Duties:**

  Fundamental Rights

  Right to Equality

  Right to Freedom

  Right against Exploitation

  Right to Freedom of Religion

  Cultural and Educational Rights

  Right to Constitutional Remedies

  Directive Principles of State Policy

Fundamental Duties.

MODULE-IV **(4 Hours)**

- **Organs of Governance:**

  Parliament

  Composition

  Qualifications and Disqualifications

  Powers and Functions

  Executive

  President

  Governor

  Council of Ministers

  Judiciary, Appointment and Transfer of Judges, Qualifications

  Powers and Functions

MODULE-V **(4 Hours)**

- **Local Administration:**

  District's Administration head: Role and Importance,

  Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation.

  Pachayati raj: Introduction, PRI: ZilaPachayat.

  Elected officials and their roles, CEO ZilaPachayat: Position and role.

  Block level: Organizational Hierarchy (Different departments),

  Village level: Role of Elected and Appointed officials,

  Importance of grass root democracy

  Model Curriculum of Engineering & Technology PG Courses [Volume -II]

MODULE-VI **(4 Hours)**

- **Election Commission:**

  Election Commission: Role and Functioning.

  Chief Election Commissioner and Election Commissioners.

  State Election Commission: Role and Functioning.

  Institute and Bodies for the welfare of SC/ST/OBC and women.

Text / Reference Books:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Outcomes: Students will be able to:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the passage of the Hindu Code Bill of 1956.

AHM105	Pedagogy Studies	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Review existing evidence on the review topic to inform programme design and policymaking undertaken by the DfID, other agencies and researchers.
2. Identify critical evidence gaps to guide the development.

MODULE-I **(4 Hours)**

- **Introduction and Methodology:**

- Aims and rationale, Policy background, Conceptual framework and terminology
- Theories of learning, Curriculum, Teacher education.
- Conceptual framework, Research questions**.**
- Overview of methodology and Searching.

MODULE-II **(2 Hours)**

- Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries.
- Curriculum, Teacher education.

MODULE-III **(4 Hours)**

- Evidence on the effectiveness of pedagogical practices
- Methodology for the in depth stage: quality assessment of included studies.
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?
- Theory of change.
- Strength and nature of the body of evidence for effective pedagogical practices.
- Pedagogic theory and pedagogical approaches.
- Teachers' attitudes and beliefs and Pedagogic strategies.

MODULE-IV **(4 Hours)**

- Professional development: alignment with classroom practices and follow up support
- Peer support
- Support from the head teacher and the community.
- Curriculum and assessment
- Barriers to learning: limited resources and large class sizes

MODULE-V **(2 Hours)**

- **Research gaps and future directions**
- Research design
- Contexts
- Pedagogy
- Teacher education
- Curriculum and assessment
- Dissemination and research impact.

Text / Reference Books:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2):245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal ofCurriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International JournalEducational

Development, 33 (3): 272–282.

5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

Course outcomes: Students will be able to understand:

1. What pedagogical practices are being used by teachers in formal and informal classrooms indeveloping countries?
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, andwith what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

AHM106	Stress Management by Yoga	2-0-0	Credits 0

Course Objectives:

1. To achieve overall health of body and mind
2. To overcome stress

MODULE-I **(8 Hours)**

- Definitions of Eight parts of yoga. (Ashtanga)

MODULE-II **(8 Hours)**

- Yam and Niyam.

  Do`s and Don't's in life.

  i) Ahinsa, satya, astheya, bramhacharya and aparigraha

  ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

MODULE-III **(8 Hours)**

- Asan and Pranayam

  i) Various yog poses and their benefits for mind & body

  ii) Regularization of breathing techniques and its effects-Types of pranayam

Text / Reference Books:

1. 'Yogic Asanas for Group Tarining-Part-I" :Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

Course outcomes: Students will be able to:

1. Develop healthy mind in a healthy body thus improving social health also
2. Improve efficiency

AHM107	Personality Development through Life Enlightenment Skills	2-0-0	Credits 0

Course Objectives:

1. To learn to achieve the highest goal happily
2. To become a person with stable mind, pleasing personality and determination
3. To awaken wisdom in students

MODULE-I **(8 Hours)**

Neetisatakam-Holistic development of personality

- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)
- Verses- 52,53,59 (dont's)
- Verses- 71,73,75,78 (do's)

MODULE-II **(8 Hours)**

Approach to day to day work and duties.

- Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48,
- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,
- Chapter 18-Verses 45, 46, 48.

MODULE-III **(8 Hours)**

Statements of basic knowledge.

- ShrimadBhagwadGeeta: Chapter2-Verses 56, 62, 68

- Chapter 12 -Verses 13, 14, 15, 16,17, 18
- Personality of Role model. Shrimad Bhagwad Geeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
- Chapter 4-Verses 18, 38,39
- Chapter18 – Verses 37,38,63

Text / Reference Books:

1. Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

Course outcomes: Students will be able to:

1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achievethe highest goal in life
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity
3. Study of Neetishatakam will help in developing versatile personality of students.

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

M.TECH SYLLABUS for *Specialization*: MECHANICAL SYSTEM DESIGN

BRANCH: MECHANICAL ENGINEERING (2018-19 Admission Batch)

First Semester				Second Semester			
Theory				**Theory**			
Course Code	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**	**Course Code**	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**
	Programme Core-1	3-0-0	3		**Programme Core-3**	3-0-0	3
MSC101	Advanced Mechanics of Solids			MSC201	Experimental Stress Analysis		
	Programme Core-2	3-0-0	3		**Programme Core-4**	3-0-0	3
MSC102	Mechanical Vibration Analysis			MSC202	Composite Material		
	Programme Elective-1 (Any One)	3-0-0	3		**Programme Elective-3 (Any One)**	3-0-0	3
MSE101	Fatigue, Creep & Fracture			MSE201	FEM in Engineering		
MSE102	Automatic Control System			MSE202	Advanced Theory of Mechanisms and Machines		
MSE103	Mechatronics			MSE203	Product Design		
	Programme Elective-2 (Any One)	3-0-0	3		**Programme Elective-4 (Any One)**	3-0-0	3
MSE104	Fault Diagnosis and Condition Monitoring			MSE204	Engineering Tribology		
MSE105	Theory of Plates and Shells			MSE205	Engineering design		
MSE106	Robotic Control						
GHM101	Research Methodology & Intellectual Property Rights	2-0-0	2		**Audit Course-2 (Any One from the list of Audit Courses)**	2-0-0	0
	Audit Course-1 (Any One from the list of Audit Courses)	2-0-0	0				
	Total (Theory)	**16**	**14**		**Total (Theory)**	**14**	**12**
	Practical/ Sessional				**Practical/ Sessional**		
	Lab-1	0-0-4	2		**Lab-3**	0-0-4	2
MSC103	Design Lab-1			MSC203	Design Lab-2		
	Lab-2	0-0-4	2		**Lab-4**	0-0-4	2
MSJ101	Seminar-1			MSJ201	Seminar-2		
				MSJ202	**Mini Project with Seminar**	0-0-4	2
Total (Practical/ Sessional)		**8**	**4**	**Total (Practical/ Sessional)**		**12**	**6**
TOTAL		**24**	**18**	**TOTAL**		**26**	**18**
TOTAL SEMESTER CREDITS: 18				TOTAL SEMESTER CREDITS: 18			
TOTAL CUMULATIVE CREDITS: 18				TOTAL CUMULATIVE CREDITS: 36			

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

M.TECH SYLLABUS for *Specialization*: MECHANICAL SYSTEM DESIGN

BRANCH: MECHANICAL ENGINEERING (2018-19 Admission Batch)

Third Semester				Fourth Semester			
Theory				**Theory**			
Course Code	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**	**Course Code**	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**
	Programme Elective-5 (Any One)	3-0-0	3				
MSE301	Applied Elasticity and Plasticity						
MSE302	Advanced Fluid Mechanics						
MSE303	Computer Aided Manufacturing						
	Open Elective (Any One)	3-0-0	3				
	Business Analytics						
	Industrial Safety						
	Operations Research						
	Cost Management of Engineering Projects						
	Composite Materials						
	Waste to Energy						
	Internet of Things						
	Soft Computing						
	Project Engineering & Management						
	Start-up & Entrepreneurship Development						
	Total (Theory)	**6**	**6**		**Total (Theory)**	**0**	**0**
	Practical/ Sessional				**Practical/ Sessional**		
MSJ301	Dissertation Phase-I	0-0-20	10	MSJ401	Dissertation Phase-II	0-0-32	16
	Total (Practical/ Sessional)	**20**	**10**		**Total (Practical/ Sessional)**	**32**	**16**
	TOTAL	**26**	**16**		**TOTAL**	**32**	**16**
TOTAL SEMESTER CREDITS: 16				TOTAL SEMESTER CREDITS: 16			
TOTAL CUMULATIVE CREDITS: 52				TOTAL CUMULATIVE CREDITS: 68			

List of Audit courses

1. AHM101 English for Research Paper Writing
2. ACE101 Disaster Management
3. AHM102 Sanskrit for Technical Knowledge
4. AHM103 Value Education
5. AHM104 Constitution of India
6. AHM105 Pedagogy Studies
7. AHM106 Stress Management by Yoga
8. AHM107 Personality Development through Life Enlightenment Skills

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

M.TECH SYLLABUS for *Specialization*: MECHANICAL SYSTEM DESIGN

BRANCH: MECHANICAL ENGINEERING (2018-19 Admission Batch)

1st Semester

MSC101	Advanced Mechanics of Solids	3-0-0	Credits 3

COURSE OBJECTIVES

1. To understand the mechanics of materials method and its application to
2. Enable to understand the structural responses to various loading conditions.
3. To help in gaining knowledge regarding loading conditions (e.g., unsymmetric bending) considered are more advanced compared to an introductory course in mechanics of materials.

MODULE-I **(8 Hours)**

Analysis of stress and Strain: 3-D dimensional stress and strain: Analysis of Stresses and Strains in rectangular and polar coordinates, Generalized Hooke's law, Relation between elastic constants, Cauchy's formula, Principal stresses and principal strains, 3D Mohr's Circle, Octahedral Stresses, Hydrostatic and deviatoric stress, Differential equations of equilibrium, Plane stress and plane strain, compatibility conditions.

Theories of failure: Factors of safety in design. Ideally plastic in solids. Yield surfaces of Tresca and von Mices. Prandtal renss and saint venant von mises equations.

MODULE-II **(8 Hours)**

Energy Theorems: Strain energy due to axial load, bending, shear and torsion, Maxwell's reciprocal theorem, Energy methods in first and second theorems of Castigliano. Maxwell-Mohr integrals asymmetric bending of beams. Analysis of helical springs by energy method.

Unsymmetrical bending & Curved Beam Theory: Shear centers for sections with one axis of symmetry, shear center for any unsymmetrical Section, stress and deflection of beams subjected to unsymmetrical bending. Winkler Bach formula for circumferential stress – Limitations – Correction factors – Radial stress in curved beams – closed ring subjected to concentrated and uniform lads- stresses in chain links.

MODULE-III **(8 Hours)**

Torsion: Torsion of a cylindrical bar of Circular cross Section; Saint-Venant's semi-inverse methods; Linear elastic solution; Prandtl elastic membrane (Soap-Film) Analogy; Narrow rectangular cross Section; Hallow thin wall torsion members, Multiply connected Cross section, Thin wall torsion members with restrained ends Axi-Symmetric Problems: Rotating Discs – Flat discs, Discs of uniform thickness, Discs of Uniform Strength, Rotating Cylinders.

MODULE-IV **(8 Hours)**

Contact Stresses: Introduction, problem of determining contact stresses; Assumptions on which a solution for contact stresses is based; Expressions for principal stresses; Methods of computing contact stresses; Deflection of bodies in point contact; Stresses for two bodies in contact over narrow rectangular area (Line contact), Loads normal to area; Stresses for two bodies in line contact. Normal and Tangent to contact area.

Buckling of columns: Beam columns single concentrated load, number of concentrated loads, continuous lateral Load, end couple, couples at both ends triangular loads.

Beam on Elastic Foundations: General theory, infinite, semi infinite, finite beams classification of beams .Beam supported by equally spaced elastic elements.

Text Book:

1. Advanced strength and applied elasticity by R.C. Ugural, S.K. Fenster, Elsevier.
2. Advanced mechanics of solids by Hugh ford Longmans.

Reference Book:

1. Strength of material by S.Timoshenko affiliated East-West press pvt.Ltd, .N. Delhi
2. Mechanics of Solids By L.S Srinath

COURSE OUTCOMES

1. Methods of three-dimensional stress and strain analysis will be extended to allow the student to obtain solutions using analytical and/or numerical methods.
2. These will include the analyses of principal stresses and strains, three dimensional Mohr's circles, strain gauge experimentation and failure criteria.
3. In addition, this unit will focus on plastic deformation of solids, including the analysis of residual stresses and the collapse load of structures.
4. The responses of materials to fatigue and fracture, as well as their creep and viscoelastic behaviour, will also be explored.
5. Finally, this unit will provide a number of examples of experimental applications of solid mechanics analysis based on modern research techniques.

MSC102	Mechanical Vibration Analysis	3-0-0	Credits 3

COURSE OBJECTIVES

1. To fully understand and appreciate the importance of vibrations in mechanical design of machine parts that operate in vibratory conditions
2. To be able to obtain linear vibratory models of dynamic systems with changing complexities (SDOF, MDOF)
3. To be able to write the differential equation of motion of vibratory systems
4. To be able to make free and forced (harmonic, periodic, non-periodic) vibration analysis of single and multi degree of freedom linear systems.

MODULE-I: **(8 Hours)**

1. Review of free and forced vibrations with and without damping. Hamilton's Principle.

2. Isolation**:** Theory of oscillation of single degree freedom system with application to Vibration isolation and vibration measurement. Vibration isolation and transmissibility; Un-damped vibration absorbers.

MODULE-II: (8 Hours)

3. Multi degree of freedom system: Generalized coordinates and coordinate coupling; Orthogonality of modes, Free and forced vibration of multi-degree of freedom systems with and without viscous damping; Lagrange's equation; Holzer's method. Solution of Eigen value problem, transfer matrix and modal analysis. Multi-degree freedom system with application to measurement. Multiple degree of freedom systems with applications to dynamic vibration absorbers. Application of matrix to vibrational problems, General theory of small oscillation of conservative systems, principlal frequencies and modes. Introduction of Rayleigh and Rayleigh-ritz Methods.

MODULE-III: (8 Hours)

4. Continuous System: Transverse vibration of a string, longitudinal vibration of a bar, torsional vibration of a shaft, transverse vibration of a beam.

MODULE-IV: (8 Hours)

5. Vibration of membranes and plates, Lap lace Transforms and operational Methods.

Text Book:

1. Mechanical Vibrations by G.K. Groover
2. Mechanical Vibration by W.T. Thompson

COURSE OUTCOMES

1. Appreciating the need and importance of vibration analysis in mechanical design of machine parts that operate in vibratory conditions
2. Ability to analyze the mathematical model of a linear vibratory system to determine its response
3. Ability to obtain linear mathematical models of real life engineering systems
4. Ability to use Lagrange's equations for linear and nonlinear vibratory systems
5. Ability to determine vibratory responses of SDOF and MDOF systems to harmonic, periodic and nonperiodic excitation
6. General notion on frequency and time response of vibratory systems

MSE101	Fatigue, Creep & Fracture	3-0-0	Credits 3

COURSE OBJECTIVES

1. Provide an understanding of the mechanics and micro-mechanisms of elastic and plastic deformation, creep, fracture, and fatigue failure, as applied to metals, ceramics, composites, thin film and biological materials.
2. Provide a thorough introduction to the principles of fracture mechanics.
3. Provide practical examples of the application of fracture mechanics to design and life prediction methods and reporting.
4. Provide a basis for the use of fractography as a diagnostic tool for structural failures.

MODULE-I **(8 Hours)**

Fracture - Basic modes of fracture, Ductile & brittle fracture, Energy release rate, Grifth theory of brittle fracture, Crack resistance, Stable and unstable crack growth, Critical energy release rate, Irwin's theory of fracture in elastic-plastic materials, theories of linear elastic fracture mechanics, Anelastic deformation at crack tip, stress intensity function, Fracture toughness testing.

MODULE-II **(8 Hours)**

Fatigue - Fatigue and endurance limit, Fatigue under normal conditions, Relation between endurance limit & ultimate tensile strength, factor of safety in fatigue loading, stress concentration, controlling factors in fatigue design, design for fatigue fracture, Theories of strength and working stress.

MODULE-III **(8 Hours)**

Growth of fatigue crack, Sigmoidal curve, Paris-Erdogan law, Effect of overload, Basquin and Manson-Coffin relation, Damage accumulation and the wholler curve.

MODULE-IV **(8 Hours)**

Creep - Low temperature properties, High temperature properties, Temperature and Creep stress-strain properties, Creep-time curve, Creep-stress-time-temperature relation for simple tension.

Mechanics of creep - Creep in tension, Creep in bending, Creep in torsion, Creep buckling, Member subjected to creep and combined stresses.

Text books:

1. Fracture Mechanics- T L Anderson (CRC press)
2. Mechanical Behavior of Engineering Material- J Marin (PHI)
3. Mechanical Metallurgy – George E. Dieter (Mc Graw-Hill)

COURSE OUTCOMES

At the end of the course the students will be able to

1. Distinguish between ductile and brittle fracture.
2. Describe a stress concentrator (also called stress raiser) and the danger it represents.
3. Distinguish between the resistance to deformation and to fracture, and name their units.
4. Explain why hard materials are more brittle than soft metals.
5. Explain why ceramics are unreliable in tensile stresses.
6. Describe fatigue, its mechanism, its consequences and what can be done to the material in order to improve fatigue resistance.
7. Measure and describe creep and name the important engineering situations where it plays a major role.

MSE102	Automatic Control System	3-0-0	Credits 3

COURSE OBJECTIVES

1. To teach the fundamental concepts of Control systems and mathematical modeling of the system
2. To study the concept of time response and frequency response of the system
3. To teach the basics of stability analysis of the system.

MODULE-I **(8 Hours)**

Closed loop & open loop systems; Linear & non-linear systems; Proportional, Derivative & integral controller; Laplace transform method; Transfer function & Block diagrams; Deriving transfer functions of physical systems; Block diagram reduction; Signal flow graphs; Construction of signal flow graphs from block diagram; Mason's gain formula.

MODULE-II **(8 Hours)**

First order systems; Second order systems; Higher order systems; Steady-state error & error constants; Routh stability criterion; Bode plot; Gain margin & Phase margin.

MODULE-III **(8 Hours)**

Root locus method; Nyquist criterion; Closed loop frequency response; M-circle & N-circle; Lag & lead compensation.

MODULE-IV **(8 Hours)**

State space analysis- State variables; State-space representation; State equations; Relationship between state equations & transfer functions; Characteristics equation; Eigen values & Eigen vectors; State diagram; Solution of state equation; State transition matrix & its properties; Transfer matrix.

Text Book

1. Modern Control Engineering, Katsuhiko Ogata, Prentice Hall, India.
2. Control Systems Engineering, L. J. Nagrath & M. Gopal, Fifth Edition, New Age International Publishers

COURSE OUTCOMES

1. Represent the mathematical model of a system
2. Determine the response of different order systems for various step inputs
3. Analyze the stability of the system

MSE103	Mechatronics	3-0-0	Credits 3

COURSE OBJECTIVES

1. To develop an ability to identify, formulate, and solve engineering problems.
2. Be able to model and analyze electrical and mechanical systems and their interconnection.
3. To develop an ability to design a system, component, or process to meet desired needs within realistic constraints.
4. Be able to integrate mechanical, electronics, control and computer engineering in the design of mechatronics systems.
5. Be able to do the complete design, building, interfacing and actuation of a mechatronic system for a set of specifications.

MODULE-I **(8 Hours)**

1. Introduction: Definition of mechatronics, measurement system, control systems, microprocessor based controllers, mechatronics approach.

2.Sensors and Transducers: Sensors and transducers, performance terminology, photoelectric transducers, flow transducers, optical sensors and transducers, semiconductor lasers, selection of sensors, mechanical / electrical switches, inputting data by switches.

MODULE-II **(8 Hours)**

3. Actuators: Actuation systems, pneumatic and hydraulic systems, process control valves, rotary actuators, mechanical actuation systems, electrical actuation systems.

4. Signal Conditioning: Signal conditioning, filtering digital signal, multiplexers, data acquisition, digital signal processing, pulse modulation, data presentation systems.

MODULE-III **(8 Hours)**

5. Microprocessors and Microcontrollers: Microcomputer structure, microcontrollers, applications, programmable logic controllers.

6. Modeling and System Response: Mathematical models, mechanical, electrical, hydraulic and thermal systems, dynamic response of systems, transfer function and frequency response, closed loop controllers.

MODULE-IV **(8 Hours)**

7. Design and Mechatronics: Input/output systems, computer based modular design, system validation, remote monitoring and control, designing, possible design solutions, detailed case studies of mechatronic systems used in photocopier, automobile, robots.

Text Book:

1. Bolton, W., "Mechatronics", Longman, 1999.
2. Bolton, W., "Mechatronics: A Multidisciplinary Approach", 4th Ed., Prentice Hall, 2009.
3. Mahalik, N., "Principles, Concept and Applications: Mechatronics", Tata McGraw, 2003.

COURSE OUTCOMES

1. Ability to design and calculate mechanical designs.
2. Ability to design and calculate electronic circuits.
3. Ability to develop software for intelligent products.
4. Ability to model and build mechatronic systems and implement these systems.
5. Ability to apply technological knowledge and theories for the development of new products.
6. Specialized knowledge within either of the profiles: Mechanical engg, Electronic engg or embedded engg.
7. Ability to carry out development projects independently and in teams.

MSE104	Fault Diagnosis and Condition Monitoring	3-0-0	Credits 3

COURSE OBJECTIVES

1. To develop an understanding of different maintenance and monitoring techniques of machineries.
2. Be able to gather knowledge on vibration monitoring and different sensors.
3. To develop an ability to monitor wear characteristics of machineries.
4. Identify lubrication oil analysis.

MODULE-I **(8 Hours)**

Introduction, Maintenance – objectives – types – concepts and economic benefits, Preventive maintenance – time based & condition based, Condition Monitoring & Performance monitoring, Vibration Monitoring – causes and effects of vibration, Review of Fundamentals of Vibrations, Vibration Measuring Equipment - Sensors, Signal conditioners, recording elements, Sensors – Factors affecting the choice of sensors, Contact type sensors – Non contact type sensors, Signal conditioning – Display/Recording elements, Vibration meters and analyser, Overall Level Measurement.

MODULE-II **(8 Hours)**

Vibration limits & Standards, Signal Analysis - Frequency Analysis, Measurement of overall vibrations levels, Case studies, Special Vibration Measuring Techniques, Shock Pulse Method, Kurtosis, Cepstrum Analysis, Critical speed analysis, Orbit, vibration control, Wear behavior monitoring and Contaminants Monitoring Technique, Filters, chip detectors, Ferrography,

MODULE-III **(8 Hours)**

Oil Analysis – oil degradation analysis, Abrasive Particle in oil, counters, Particle classification and counter, spectrometric oil analysis, Performance trend monitoring – Primary and secondary parameters, Performance trend analysis, Performance trend monitoring systems, Corrosion Monitoring – different techniques, Selection of condition motoring techniques, Non-destructive techniques – important features, Types of defects detected by NDT – Visual, Dye Penetration, Acoustic Emission and its applications, X-ray, Radiographic, Magnetic Flux test etc, Application of NDT Techniques.

TEXT BOOKS:

1. Isermann R., Fault Diagnosis Applications, Springer-Verlag, Berlin, 2011.
2. Rao, J S., Vibration Condition Monitoring, Narosa Publishing House, 2nd Edition, 2000.
3. Allan Davies, Handbook of Condition Monitoring, Chapman and Hall, 2000.

COURSE OUTCOMES

1. Understand the maintenance scheme, their scope and limitations – apply the maintenance strategies to various problems in the industrial sectors.
2. Analyze for machinery condition monitoring and explain how this compliments monitoring the condition.
3. Develop an appreciation for the need of modern technological approach for plant maintenance to reduce the maintenance expenditure.
4. Emphasizes on case studies that require gathering information using the modern testing equipment and processing it to identify the malfunction in that system.
5. Identify vibration measurement, lubrication oil analysis.

MSE105	Theory of Plates and Shells	3-0-0	Credits 3

COURSE OBJECTIVES

1. Introduce students to the classical structural mechanics approximations of Membrane, Plate and Shell theories.
2. Use energy formulations to demonstrate the consistent derivation of approximate boundary conditions and edge effects.
3. Demonstrate the analysis tools necessary to describe static, dynamic and non-linear motions.

4. Demonstrate the approximation of the classical formulations using numerical approximation techniques.

MODULE-I **(8 Hours)**

1. Introduction: Assumptions in the theory of thin plates, Pure bending of Plates, Relations between bending moments and curvature, Particular cases of pure bending of rectangular plates, Cylindrical bending, Strain energy in pure bending of plates in Cartesian and polar co-ordinates, Limitations.

2. Laterally Loaded Rectangular Plates: Differential equation of plates, Boundary conditions, Navier solution for simply supported plates subjected to uniformly distributed load and point load, Levy's method of solution for plates, Simply supported plates with moments distributed along the edges, Approximate Methods.

MODULE-II **(8 Hours)**

3. Effect of transverse shear deformation: plates of variable thickness, Anisotropic plates, thick plates, orthotropic plates and grids, Large Deflection theory.

MODULE-III **(8 Hours)**

4. Deformation of Shells without Bending: Definitions and notation, shells in the form of a surface of revolution, displacements, membrane theory of cylindrical shells, the use of stress function in calculating membrane forces of shells.

MODULE-IV **(8 Hours)**

5. General Theory of Cylindrical Shells: A circular cylindrical shell loaded symmetrically with respect to its axis, symmetrical deformation, pressure vessels, cylindrical tanks, general case of deformation, the use of a strain and stress function, stress analysis of cylindrical roof shells.

TEXT BOOK

1. Theory of Plates and Shells by Stephen P. Timoshenko, Sergius Woinowsky-Krieger (McGraw- Hill)
2. Thin Plates and Shells: Theory: Analysis, and Applications by Eduard Ventsel, Theodor Krauthammer (CRC)

REFERENCES

1. Mechanics of Laminated Composite Plates and Shells: Theory and Analysis by J. N. Reddy (CRC)

COURSE OUTCOMES

On completion of the course, students can:

1. Apply the structural mechanics approximations of membrane, plates and shells.
2. Derive simple modifications to the membrane plate and shell theories.

3. Use analysis to determine the static, dynamic, and non-linear motion of membrane, plate and shell structures.
4. Compute numerical approximations.

MSE106	Robotic Control	3-0-0	Credits 3

COURSE OBJECTIVES

1. Automation for industries by various techniques
2. Robot design with controlling parts.
3. To Batch production techniques

MODULE-I **(12 Hours)**

Robotics: Historical background, Definitions, Laws of Robotics, Robotic system and robot anatomy, common robot configurations. Coordinate system, work envelop, Elements of robotic system – end effector, actuators, controller, teach pendant, sensors, Specification of robots. Applications, safety measures.

MODULE-II **(8 Hours)**

Robot Kinematics: Forward and reverse Kinematics of 3-DOF and 4-DOF Robot arms. Actuators: Hydraulic actuators, Pneumatic actuators, Electrical actuators. Directional control, servo control, Flow control valves.

MODULE-III **(8 Hours)**

End effectors: Classification, Drive systems, Magnetic, Mechanical, Vacuum and Adhesive grippers, Force analysis in a gripper. Sensors: Need for sensing systems, sensory devices, Types of sensors, robot vision system. Robot Languages and Programming.

Text Book(s):

1. Robotics Technology and Flexible Automation: S. R. Deb.Tata McGraw Hill.

Reference Book(s)

1. Robotics: Lee, Fu, Gonzalez, Mc Graw Hill 2. Industrial Robots: Groover, Mc Graw Hill

COURSE OUTCOMES:

1. Identify the components of a robot
2. Program robots for different applications
3. Introduce robots in various in various manufacturing techniques

MSC103	Design Lab-1	0-0-4	Credits 2

List of Experiments:

A. Material Testing Laboratory

1. To calculate the Young's Modulus of Elasticity of a given specimen using Universal Testing Machine
2. To determine the hardness of given specimens using Rockwell Hardness tester machine

B. Machine Dynamics Laboratory

1. To determine the natural frequency of damped and undamped vibration.
2. To determine the critical speed of shaft.
3. To study the effect of speed, viscosity and load on pressure distribution of a journal bearing.
4. To determine the natural frequency of undamped torsional vibration of a 3-rotor shaft system.
5. To verify the strain in an external loaded beam with the help of strain gauge indicator and to verify theoretically.

C. Tribology

1. To determine the wear of a given specimen in Pin-on-Disc Tribometer.
2. To determine the viscosity of oil using sphere viscometer.
3. To test the erosion resistance of a material using air jet erosion test rig/ abrasive slurry test rig.

GHM101	Research Methodology & Intellectual Property Rights	2-0-0	Credits 2

MODULE-I **(06 Hours)**

Meaning of research problem, Sources of research problem, Criteria characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.

Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

MODULE-II **(04 Hours)**

Effective literature studies approaches, analysis,

Plagiarism, Research ethics.

MODULE-III **(04 Hours)**

Effective technical writing, how to write report, Paper.

Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

MODULE-IV **(06 Hours)**

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

MODULE-V **(04 Hours)**

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

MODULE-VI **(04 Hours)**

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Text/Reference Books:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science& engineering students'".
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.

5. Mayall, “Industrial Design”, McGraw Hill, 1992.
6. Niebel, “Product Design”, McGraw Hill, 1974.
7. Asimov, “Introduction to Design”, Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “Intellectual Property in New Technological Age”, 2016.
9. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008

Course Outcomes: At the end of the course, students will be able to

1. Understand research problem formulation.
2. Analyze research related information
3. Follow research ethics
4. Understand that today’s world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property.

   Right to be promoted among students in general & engineering in particular.
6. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Audit Courses

AHM101	English for Research Paper Writing	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Understand that how to improve your writing skills and level of readability
2. Learn about what to write in each section
3. Understand the skills needed when writing a Title

   Ensure the good quality of paper at very first-time submission

MODULE-I **(4 Hours)**

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

MODULE-II **(4 Hours)**

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction.

MODULE-III **(4 Hours)**

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

MODULE-IV **(4 Hours)**

key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed whenwriting a Review of the Literature.

MODULE-V **(4 Hours)**

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions.

MODULE-VI **(4 Hours)**

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

Suggested Studies:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book.

4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

ACE101	Disaster Management	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

MODULE-I **(4 Hours)**

Introduction

Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

MODULE-II **(4 Hours)**

Repercussions of Disasters and Hazards:

Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem.

Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

MODULE-III **(4 Hours)**

Disaster Prone Areas In India

Study of Seismic Zones; Areas Prone To Floods And Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics

MODULE-IV **(4 Hours)**

Disaster Preparedness and Management

Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data From Meteorological and Other Agencies, Media Reports: Governmental and

Community Preparedness.

MODULE-V **(4 Hours)**

Risk Assessment

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategiesfor Survival.

MODULE-VI **(4 Hours)**

Disaster Mitigation

Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation In India.

Text / Reference Books:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies, New Royal book Company.
2. Sahni, Pardeep et.al. (Eds.)," Disaster Mitigation Experiences and Reflections", Prentice Hall Of India, New Delhi.
3. Goel S. L., Disaster Administration and Management Text and Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi.

AHM102	Sanskrit for Technical Knowledge	2-0-0	Credits 0

Course Objectives:

1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. Learning of Sanskrit to improve brain functioning
3. Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power
4. The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature

MODULE-I **(8 Hours)**

- Alphabets in Sanskrit
- Past/Present/Future Tense
- Simple Sentences

MODULE-II **(8 Hours)**

- Order
- Introduction of roots
- Technical information about Sanskrit Literature

MODULE-III **(8 Hours)**

- Technical concepts of Engineering-Electrical, Mechanical,Architecture, Mathematics

Suggested reading:

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

Course Output: Students will be able to

1. Understanding basic Sanskrit language
2. Ancient Sanskrit literature about science & technology can be understood
3. Being a logical language will help to develop logic in students

AHM103	Value Education	2-0-0	Credits 0

Course Objectives: Students will be able to

1. Understand value of education and self- development
2. Imbibe good values in students
3. Know about the importance of character

MODULE-I **(6 Hours)**

- Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism.
- Moral and non- moral valuation. Standards and principles.
- Value judgements

MODULE-II **(6 Hours)**

- Importance of cultivation of values.
- Sense of duty.Devotion, Self-reliance.Confidence, Concentration. Truthfulness, Cleanliness.
- Honesty, Humanity.Power of faith, National Unity.
- Patriotism.Love for nature, Discipline

MODULE-III **(6 Hours)**

- Personality and Behavior Development - Soul and Scientific attitude.
- Positive Thinking. Integrity and discipline.
- Punctuality, Love and Kindness.
- Avoid fault Thinking.
- Free from anger, Dignity of labour.
- Universal brotherhood and religious tolerance.
- True friendship.
- Happiness Vs suffering, love for truth.
- Aware of self-destructive habits.
- Association and Cooperation.
- Doing best for saving nature

MODULE-IV **(6 Hours)**

- Character and Competence –Holy books vs Blind faith.
- Self-management and Good health.
- Science of reincarnation.
- Equality, Nonviolence, Humility, Role of Women.
- All religions and same message.
- Mind your Mind, Self-control.
- Honesty, Studying effectively

Text / Reference Books

1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

Course outcomes: Students will be able to

1. Knowledge of self-development

2. Learn the importance of Human values
3. Developing the overall personality

AHM104	Constitution of India	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutionalrole and entitlement to civil and economic rights as well as the emergence of nationhood inthe early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the BolshevikRevolution in 1917 and its impact on the initial drafting of the Indian Constitution.

MODULE-I **(4 Hours)**

- **History of Making of the Indian Constitution:**

  History

  Drafting Committee, (Composition& Working)

MODULE-II **(4 Hours)**

- **Philosophy of the Indian Constitution:**

  Preamble

  Salient Features

MODULE-III **(4 Hours)**

- **Contours of Constitutional Rights & Duties:**

  Fundamental Rights

  Right to Equality

  Right to Freedom

  Right against Exploitation

  Right to Freedom of Religion

  Cultural and Educational Rights

  Right to Constitutional Remedies

  Directive Principles of State Policy

Fundamental Duties.

MODULE-IV **(4 Hours)**

- **Organs of Governance:**

  Parliament

  Composition

  Qualifications and Disqualifications

  Powers and Functions

  Executive

  President

  Governor

  Council of Ministers

  Judiciary, Appointment and Transfer of Judges, Qualifications

  Powers and Functions

MODULE-V **(4 Hours)**

- **Local Administration:**

  District's Administration head: Role and Importance,

  Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation.

  Pachayati raj: Introduction, PRI: ZilaPachayat.

  Elected officials and their roles, CEO ZilaPachayat: Position and role.

  Block level: Organizational Hierarchy (Different departments),

  Village level: Role of Elected and Appointed officials,

  Importance of grass root democracy

  Model Curriculum of Engineering & Technology PG Courses [Volume -II]

MODULE-VI **(4 Hours)**

- **Election Commission:**

  Election Commission: Role and Functioning.

  Chief Election Commissioner and Election Commissioners.

  State Election Commission: Role and Functioning.

  Institute and Bodies for the welfare of SC/ST/OBC and women.

Text / Reference Books:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Outcomes: Students will be able to:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the passage of the Hindu Code Bill of 1956.

AHM105	Pedagogy Studies	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Review existing evidence on the review topic to inform programme design and policymaking undertaken by the DfID, other agencies and researchers.
2. Identify critical evidence gaps to guide the development.

MODULE-I **(4 Hours)**

- **Introduction and Methodology:**
- Aims and rationale, Policy background, Conceptual framework and terminology
- Theories of learning, Curriculum, Teacher education.
- Conceptual framework, Research questions**.**
- Overview of methodology and Searching.

MODULE-II **(2 Hours)**

- Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries.
- Curriculum, Teacher education.

MODULE-III **(4 Hours)**

- Evidence on the effectiveness of pedagogical practices
- Methodology for the in depth stage: quality assessment of included studies.
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?
- Theory of change.
- Strength and nature of the body of evidence for effective pedagogical practices.
- Pedagogic theory and pedagogical approaches.
- Teachers' attitudes and beliefs and Pedagogic strategies.

MODULE-IV **(4 Hours)**

- Professional development: alignment with classroom practices and follow up support
- Peer support
- Support from the head teacher and the community.
- Curriculum and assessment
- Barriers to learning: limited resources and large class sizes

MODULE-V **(2 Hours)**

- **Research gaps and future directions**
- Research design
- Contexts
- Pedagogy
- Teacher education
- Curriculum and assessment
- Dissemination and research impact.

Text / Reference Books:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2):245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal ofCurriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International JournalEducational

Development, 33 (3): 272–282.

5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

Course outcomes: Students will be able to understand:

1. What pedagogical practices are being used by teachers in formal and informal classrooms indeveloping countries?
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, andwith what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

AHM106	Stress Management by Yoga	2-0-0	Credits 0

Course Objectives:

1. To achieve overall health of body and mind
2. To overcome stress

MODULE-I **(8 Hours)**

- Definitions of Eight parts of yoga. (Ashtanga)

MODULE-II **(8 Hours)**

- Yam and Niyam.

  Do`s and Don't's in life.

  i) Ahinsa, satya, astheya, bramhacharya and aparigraha

  ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

MODULE-III **(8 Hours)**

- Asan and Pranayam

  i) Various yog poses and their benefits for mind & body

  ii) Regularization of breathing techniques and its effects-Types of pranayam

Text / Reference Books:

1. 'Yogic Asanas for Group Tarining-Part-I" :Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

Course outcomes: Students will be able to:

1. Develop healthy mind in a healthy body thus improving social health also
2. Improve efficiency

AHM107	Personality Development through Life Enlightenment Skills	2-0-0	Credits 0

Course Objectives:

1. To learn to achieve the highest goal happily
2. To become a person with stable mind, pleasing personality and determination
3. To awaken wisdom in students

MODULE-I **(8 Hours)**

Neetisatakam-Holistic development of personality

- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)
- Verses- 52,53,59 (dont's)
- Verses- 71,73,75,78 (do's)

MODULE-II **(8 Hours)**

Approach to day to day work and duties.

- Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48,
- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,
- Chapter 18-Verses 45, 46, 48.

MODULE-III **(8 Hours)**

Statements of basic knowledge.

- Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68

- Chapter 12 -Verses 13, 14, 15, 16,17, 18
- Personality of Role model. Shrimad Bhagwad Geeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
- Chapter 4-Verses 18, 38,39
- Chapter18 – Verses 37,38,63

Text / Reference Books:

1. Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

Course outcomes: Students will be able to:

1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achievethe highest goal in life
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity
3. Study of Neetishatakam will help in developing versatile personality of students.

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

M.TECH SYLLABUS for *Specialization*: PRODUCTION ENGINEERING

BRANCH: MECHANICAL ENGINEERING (2018-19 Admission Batch)

First Semester				Second Semester			
Theory				**Theory**			
Course Code	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**	**Course Code**	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**
	Programme Core-1	3-0-0	3		**Programme Core-3**	3-0-0	3
PRC101	Theory of Plasticity and Metal Forming Process			PRC201	Non-Traditional Manufacturing Process		
	Programme Core-2	3-0-0	3		**Programme Core-4**	3-0-0	3
PRC102	Theory of Machining			PRC202	Industrial Engineering		
	Programme Elective-1 (Any One)	3-0-0	3		**Programme Elective-3 (Any One)**	3-0-0	3
PRE101	Advanced Casting & Welding			PRE201	Inspection and Quality Assurance		
PRE102	Machine Tool Technology			PRE202	Finite Element Methods		
PRE103	Tools and Dies Design			PRE203	Soft Computing for Intelligent Manufacturing		
	Programme Elective-2 (Any One)	3-0-0	3		**Programme Elective-4 (Any One)**	3-0-0	3
PRE104	Robotics and Flexible Manufacturing			PRE204	Operation Management		
PRE105	Computer Aided Design and Manufacturing			PRE205	Human Resource Management		
MSE103	Mechatronics			PRE206	Inventory System		
GHM101	Research Methodology & Intellectual Property Rights	2-0-0	2		**Audit Course-2 (Any One from the list of Audit Courses)**	2-0-0	0
	Audit Course-1 (Any One from the list of Audit Courses)	2-0-0	0				
	Total (Theory)	**16**	**14**		**Total (Theory)**	**14**	**12**
	Practical/ Sessional				**Practical/ Sessional**		
	Lab-1	0-0-4	2		**Lab-3**	0-0-4	2
PRC103	Metal Forming & Machining Lab			PRC203	Non-Traditional Manufacturing Lab		
	Lab-2	0-0-4	2		**Lab-4**	0-0-4	2
PRJ101	Seminar			PRC204	Industrial Engineering and Ergonomics Lab		
				PRJ201	**Mini Project with Seminar**	0-0-4	2
	Total (Practical/ Sessional)	**8**	**4**		**Total (Practical/ Sessional)**	**12**	**6**
	TOTAL	**24**	**18**		**TOTAL**	**26**	**18**
TOTAL SEMESTER CREDITS: 18				TOTAL SEMESTER CREDITS: 18			
TOTAL CUMULATIVE CREDITS: 18				TOTAL CUMULATIVE CREDITS: 36			

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

M.TECH SYLLABUS for *Specialization*: PRODUCTION ENGINEERING

BRANCH: MECHANICAL ENGINEERING (2018-19 Admission Batch)

Third Semester				Fourth Semester			
Theory				**Theory**			
Course Code	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**	**Course Code**	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**
	Programme Elective-5 (Any One)	3-0-0	3				
PRE301	Rapid Prototyping						
PRE302	Nanotechnology						
PRE303	Concurrent Engineering						
	Open Elective (Any One)	3-0-0	3				
	Business Analytics						
	Industrial Safety						
	Operations Research						
	Cost Management of Engineering Projects						
	Composite Materials						
	Waste to Energy						
	Internet of Things						
	Soft Computing						
	Project Engineering & Management						
	Start-up & Entrepreneurship Development						
	Total (Theory)	**6**	**6**		**Total (Theory)**	**0**	**0**
	Practical/ Sessional				**Practical/ Sessional**		
PRJ301	Dissertation Phase-I	0-0-20	10	PRJ401	Dissertation Phase-II	0-0-32	16
	Total (Practical/ Sessional)	**20**	**10**		**Total (Practical/ Sessional)**	**32**	**16**
	TOTAL	**26**	**16**		**TOTAL**	**32**	**16**
TOTAL SEMESTER CREDITS: 16				TOTAL SEMESTER CREDITS: 16			
TOTAL CUMULATIVE CREDITS: 52				TOTAL CUMULATIVE CREDITS: 68			

List of Audit courses

1. AHM101 English for Research Paper Writing
2. ACE101 Disaster Management
3. AHM102 Sanskrit for Technical Knowledge
4. AHM103 Value Education
5. AHM104 Constitution of India
6. AHM105 Pedagogy Studies
7. AHM106 Stress Management by Yoga
8. AHM107 Personality Development through Life Enlightenment Skills

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

M.TECH SYLLABUS for *Specialization*: PRODUCTION ENGINEERING

BRANCH: MECHANICAL ENGINEERING (2018-19 Admission Batch)

1st Semester

PRC101	Theory of Plasticity and Metal Forming Process	3-0-0	Credits 3

Course Objectives:

1. To study various metal forming processes
2. Plastic deformation during forming processes
3. Different laws and equations developed for solving metal forming problems

Course Contents:

MODULE-I **(10 Hours)**

Fundamentals plasticity: True stress-strain curve. Bauschinger effect. Empirical equations to stress strain curves. Three-dimensional stress and strain invariants and strain.

MODULE-II **(8 Hours)**

Yield criteria of materials: Tresca and Von-Mises theory, Prandtl Reuss and Levy Mises stress strain relations, work hardening.

MODULE-III **(10 Hours)**

Equilibrium approach: Concepts of friction in metal forming, Coulumb friction and constant shear friction factor (m). Application of stress equilibrium approach to extrusion, drawing, rolling and forging.

Text Book(s):

1. Engineering Plasticity – W. Johnson (Von Nostrand)
2. Mechanical Metallurgy – Dieter (Mc Graw Hill)

Reference Book(s)

1. An Introduction to Principles of Metal Working – G.W.Rowe
2. Metal Forming: Processes and Analysis – Avitzur (TMH)

Course Outcomes:

1. Recognize the various metal forming techniques
2. Apply the theory of plasticity and its application for analyzing various metal forming Processes
3. Describe the advancement in forming technologies

PRC102	Theory of Machining	3-0-0	Credits 3

Course Objectives:

1. Study of various machining processes
2. Material removal methods, input parameters during machining
3. Theoretical derivation of equations for temperature, strain, force
4. Tool wear mechanism, Automation during machining

Course Contents:

MODULE-I **(14 Hours)**

Basic shapes of machining tools, Wedge action, function of different angles of cutting tools, tool geometry and Nomenclatures-ASA, ORS, NRS systems. Conversion of angles, Geometry of twist dill & slab milling cutter, Mechanism of chip formation, mode of failure under stress, fracture & yielding mechanism, types of chips, factors involved in chip formation, shear plane, effect of cutting variables on chip reduction coefficient, chip formation in drilling and milling

MODULE-II **(8 Hours)**

Force system in turning, Merchant circle diagram, velocity relationship and Kronenberg relationship. Stress in conventional shear plane. Energy of cutting process, restricted cutting, Force analysis during oblique cutting. Earnest & Merchant angle relationship, Lee-shafer relationship, Forces in drilling & plane slab milling, Measurement of forces-dynamometer for measuring turning & drilling forces

MODULE-III **(10 Hours)**

Thermodynamics of chip formation-The shear plane temperature-Interface temperature from dimensional analysis-Experimental determination of chip tool Interface temperature. Coolants-Theory of cutting fluid action at the chip tool interface, Techniques for application of cutting fluids, Tool Wear: Criteria of wear, Machinability and tool life, Flank wear-Taylor's tool life equation, crater wear, causes & mechanism of tool failure

Text Books:

1. Metal Cutting Theory and Practice, A. Bhattachary, New Central Book Agency (P) Ltd.
2. Machining and Machine Tools, A. B. Chattopadhyay, Wiley-India Publication.
3. Metal Cutting Principles, M. C. Shaw, Oxford University Press.

Course Outcome:

1. Select suitable machining process for suitable materials
2. Select optimum parameters for the respective machining process
3. Summarizes the merits advantages of high speed machining process

PRE101	Advanced Casting & Welding	3-0-0	Credits 3

Course Objectives:

1. Study of various metal casting and joining processes
2. Control of parameters for sound casting and welding
3. Thermal and fluid transfer mechanism during these processes
4. Metallurgical effects of casting and joining

Course Contents:

MODULE-I **(10 Hours)**

Gating system for casting, Elements of a gating system, Sprue, Sprue base well, Gates, Gating System Design, Pouring time, Choke area, Gating Ratios, Ingate design, Slag Trap Systems, Risering Design, Caine's Method, Modulus Method, Naval Research Lab Method, Chills, Feeding aids

MODULE-II **(10 Hours)**

Solidification of Metals, Freezing of a pure Metal, Nucleation and Growth, Shrinkage, freezing of alloys, Thermal characteristics of the mould, casting defects, gas defects, pouring metal defects, Metallurgical defects.

MODULE-III **(10 Hours)**

Basic Metallurgy of fusion welds, general theory of solidification of metals and alloys, homogeneous and heterogeneous nucleation, Effect of welding speed on grain structure, properties of weld metals, fusion boundary zone, heat affected zone, properties of heat affected zone, Welding stress and distortion, residual stress, causes of residual stress, effect of weld thermal cycle and shrinkage on residual stresses, Reaction stresses, stresses generated by phase transformation, Measurement and calculation of residual stresses in weld metals.

Text Books:

1. Manufacturing Technology, Vol.1 P.N.Rao, TATA Mc Graw Hill 2. Welding Engineering and Technology by R.S.Parmar, Khanna Publication

Course Outcomes:

1. Discriminate the knowledge of principles, operations and applications of different casting and welding processes.
2. Analyze the effects of process parameters on the quality of cast and weld products.
3. Select the NDT techniques for the evaluation of cast and weld components.
4. Apply the knowledge of welding in Heavy Engineering and nuclear industries.

PRE102	Machine Tool Technology	3-0-0	Credits 3

Course Objectives:

1. Study of various machine internal parts
2. Dynamics of machining by varying parameters
3. Automation of machine parts

Course Contents:

MODULE-I **(6 Hours)**

General classification of machine tools, working and auxiliary motions, Hydraulics transmission and its elements, Mechanical transmission and its elements, General requirement of machine tools.

MODULE-II **(8 Hours)**

Kinematics of Machine Tools – Stepped and step less drive, Basic considerations in the design of drives, Variable speed range in machine tools, Graphical representation of speed, structure diagram, selection of optimum ray diagram, Design of speed and feed gear boxes, step-less regulation of speed and feed rates.

MODULE-III **(8 Hours)**

Machine tool Structures: Design criteria, materials, static and dynamic stiffness, Basic dynamic stiffness, Basic design procedure, design of beds and columns, Model technique in design of machine tool structures.

Text Books:

1. Machine Tools Design, N. K. Meheta, TMH.
2. Design of Machine Tools, S. K. Basu, D. K. Pal, OIBH.
3. Principles of Machine Tools, G. C. Sen, Bhattacharya, New Central Book Agency.
4. Metal Cutting Theory and Practice, A. Bhattachary, New Central Book Agency (P) Ltd.
5. Machining and Machine Tools, A. B. Chattopadhyay, Wiley-India Publication.

Course Outcome:

1. Identify various parts of machine tools
2. Apply various design aspects of spindles and bearings
3. Reduce vibration and chatter developing on machine tools

PRE103	Tools and Dies Design	3-0-0	Credits 3

Course Objectives:

1. Types of tools for heavy machining processes
2. Design elements in sheet metal operation
3. Use of jigs and fixtures for automation in industries

Course Contents:

MODULE-I **(5 Hours)**

System approach to production design, Elements of a product manufacturing facility, materials selection, interchangeability & standardization, use of new technology, value engineering and analysis, cost analysis.

MODULE-II **(12 Hours)**

Design of single-point cutting tools, Tool strength and rigidity calculation, selection of tool angles, chip breakers, carbide, tipped tools, High production cutting tools. Form Tools: Types of form tools, method of determining the profile of circular and flat form of tool, analytical and graphical method. Cutting process in broaching, geometric elements of broach teeth, Design of Internal & external surface broach, calculation of no. of teeth, Rigidity, cutting force, power.

MODULE-III **(13 Hours)**

Forging Design-Allowances, Forging process, Forging die design, Drop forging Dies and auxiliary tools, Upset forging. Design for sheet metal works: Press working-shearing action, center of pressure, clearance, cutting force, Die block design, punch design, punch support, stop, pilot, stripper, knockout, blanking & piercing die design, progressive & compound die design, Drawing dies, metal flow, Blank diameter, Drawing force.

Text Book(s):

1. Fundamentals of Tool Design: ASTME, PHI
2. Metal Cutting Theory & Cutting Tool Design: Arshinov, MIR Pub.
3. A Text Book of Production Engg.: P.C.Sharma, S.Chand & Co
4. Tool Design: Donaldson, Le Cain, Goold, TMH
5. Fundamentals of Tool Engg. Design: Basu, Mukherjee, Mishra, Oxford & IBH.

Course Outcomes:

1. Design of new concepts of manufacturing methods
2. Use of various forming methods for making heavy duty products
3. Automation of various elements for industries applications
4. Methods designed for mass production

PRE104	Robotics and Flexible Manufacturing	3-0-0	Credits 3

Course Objectives:

1. Automation for industries by various techniques
2. Robot design with controlling parts
3. Batch production techniques
4. Recent development occurred for FMS

Course Contents:

MODULE-I **(12 Hours)**

Robotics: Historical background, Definitions, Laws of Robotics, Robotic system and robot anatomy, common robot configurations. Coordinate system, work envelop, Elements of robotic system – end effector, actuators, controller, teach pendant, sensors, Specification of robots. Applications, safety measures.

MODULE-II **(8 Hours)**

Robot Kinematics: Forward and reverse Kinematics of 3-DOF and 4-DOF Robot arms. [8] Actuators: Hydraulic actuators, Pneumatic actuators, Electrical actuators. Directional control, servo control, Flow control valves.

MODULE-III **(8 Hours)**

End effectors: Classification, Drive systems, Magnetic, Mechanical, Vacuum and Adhesive grippers, Force analysis in a gripper.Sensors: Need for sensing systems, sensory devices, Types of sensors, robot vision system. Robot Languages and Programming.

Text Book(s):

1. Robotics Technology and Flexible Automation: S. R. Deb.Tata Mc Graw Hill.

Reference Book(s)

1. Robotics: Lee, Fu, Gonzalez, Mc Graw Hill 2. Industrial Robots: Groover, Mc Graw Hill

Course Outcome:

1. Identify the components of a robot
2. Program robots for different applications
3. Introduce robots in various in various manufacturing techniques

PRE105	Computer Aided Design and Manufacturing	3-0-0	Credits 3

Course Objectives:

1. Developments of software computer interface in design of various elements
2. Use of software for manufacturing
3. Automation of manufacturing methods

Course Contents:

MODULE-I **(8 Hours)**

Fundamentals of CAD: The design process, applications of computer for design, creating the Manufacturing, Database, The design workstation, Graphical Terminal, Operator input Devices, Plotters and other devices, the CPU secondary storage

MODULE-II **(8 Hours)**

Computer graphics Software and Database: Configuration, Graphics Packages, Constructing the Geometry, transformations, Database structure and content, wire frame versus solid modeling

MODULE-III **(12 Hours)**

Problems with conventional NC, NC technology: CNC, DNC combined DNC/CNC system, Adopter control manufacturing systems, Computer Integrated manufacturing system, Machine Tools and related Equipment, Materials Handling and Storage system, computer system

Text Book(s):

1. Computer Aided design and Manufacture, Grover M.P.Simmers, E.W. Prentice Hall
2. CAD/CAM/CIM P.Radhakrishnan & Subramanyam, Willey Eastern Limited.
3. Automation, Production System and CIM, Goover, Prentice hall

Course Outcomes:

1. Define the principles of optimum design
2. Apply surface modelling techniques
3. Analyze production systems at operation level

MSE103	Mechatronics	3-0-0	Credits 3

COURSE OBJECTIVES

1. To develop an ability to identify, formulate, and solve engineering problems.

2. Be able to model and analyze electrical and mechanical systems and their interconnection.
3. To develop an ability to design a system, component, or process to meet desired needs within realistic constraints.
4. Be able to integrate mechanical, electronics, control and computer engineering in the design of mechatronics systems.
5. Be able to do the complete design, building, interfacing and actuation of a mechatronic system for a set of specifications.

MODULE-I **(8 Hours)**

1. Introduction: Definition of mechatronics, measurement system, control systems, microprocessor based controllers, mechatronics approach.

2.Sensors and Transducers: Sensors and transducers, performance terminology, photoelectric transducers, flow transducers, optical sensors and transducers, semiconductor lasers, selection of sensors, mechanical / electrical switches, inputting data by switches.

MODULE-II **(8 Hours)**

3. Actuators: Actuation systems, pneumatic and hydraulic systems, process control valves, rotary actuators, mechanical actuation systems, electrical actuation systems.

4. Signal Conditioning: Signal conditioning, filtering digital signal, multiplexers, data acquisition, digital signal processing, pulse modulation, data presentation systems.

MODULE-III **(8 Hours)**

5. Microprocessors and Microcontrollers: Microcomputer structure, microcontrollers, applications, programmable logic controllers.

6. Modelling and System Response: Mathematical models, mechanical, electrical, hydraulic and thermal systems, dynamic response of systems, transfer function and frequency response, closed loop controllers.

MODULE-IV **(8 Hours)**

7. Design and Mechatronics: Input/output systems, computer based modular design, system validation, remote monitoring and control, designing, possible design solutions, detailed case studies of mechatronic systems used in photocopier, automobile, robots.

Text Book:

1. Bolton, W., "Mechatronics", Longman, 1999.
2. Bolton, W., "Mechatronics: A Multidisciplinary Approach", 4th Ed., Prentice Hall, 2009.
3. Mahalik, N., "Principles, Concept and Applications: Mechatronics", Tata McGraw, 2003.

COURSE OUTCOMES

1. Ability to design and calculate mechanical designs.
2. Ability to design and calculate electronic circuits.
3. Ability to develop software for intelligent products.
4. Ability to model and build mechatronic systems and implement these systems.
5. Ability to apply technological knowledge and theories for the development of new products.
6. Specialized knowledge within either of the profiles: Mechanical engg, Electronic engg or embedded engg.
7. Ability to carry out development projects independently and in teams

PRC103	Metal Forming & Machining Lab	0-0-4	Credits 2

List of Experiments:

1. **Metal Forming-** Determination of tensile test/Metal Strength/ Bend
2. Extrusion of FRP/Injection

Machining

3. Cutting force measurement by turning tool dynamometer.
4. Measurement of surface roughness in surface grinding.
5. Programming in CNC Lathe.

Casting

6. Composite metal casting/ Stirr casting.
7. Investment casting (using wax etc.)

Welding

8. Arc welding & its study of process parameters.
9. TIG & study of its process variables.
10. Design and fabrication of object concerning welding and forming.

GHM101	Research Methodology & Intellectual Property Rights	2-0-0	Credits 2

MODULE-I **(06 Hours)**

Meaning of research problem, Sources of research problem, Criteria characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.

Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

MODULE-II **(04 Hours)**

Effective literature studies approaches, analysis,

Plagiarism, Research ethics.

MODULE-III **(04 Hours)**

Effective technical writing, how to write report, Paper.

Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

MODULE-IV **(06 Hours)**

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

MODULE-V **(04 Hours)**

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

MODULE-VI **(04 Hours)**

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Text/Reference Books:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science& engineering students'".
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.

5. Mayall, “Industrial Design”, McGraw Hill, 1992.
6. Niebel, “Product Design”, McGraw Hill, 1974.
7. Asimov, “Introduction to Design”, Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “Intellectual Property in New Technological Age”, 2016.
9. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008

Course Outcomes: At the end of the course, students will be able to

1. Understand research problem formulation.
2. Analyze research related information
3. Follow research ethics
4. Understand that today’s world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property.

   Right to be promoted among students in general & engineering in particular.
6. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Audit Courses

AHM101	English for Research Paper Writing	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Understand that how to improve your writing skills and level of readability
2. Learn about what to write in each section
3. Understand the skills needed when writing a Title

   Ensure the good quality of paper at very first-time submission

MODULE-I **(4 Hours)**

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

MODULE-II **(4 Hours)**

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction.

MODULE-III **(4 Hours)**

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

MODULE-IV **(4 Hours)**

key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed whenwriting a Review of the Literature.

MODULE-V **(4 Hours)**

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions.

MODULE-VI **(4 Hours)**

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

Suggested Studies:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book.

4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

ACE101	Disaster Management	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

MODULE-I **(4 Hours)**

Introduction

Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

MODULE-II **(4 Hours)**

Repercussions of Disasters and Hazards:

Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem.

Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

MODULE-III **(4 Hours)**

Disaster Prone Areas In India

Study of Seismic Zones; Areas Prone To Floods And Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics

MODULE-IV **(4 Hours)**

Disaster Preparedness and Management

Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data From Meteorological and Other Agencies, Media Reports: Governmental and

Community Preparedness.

MODULE-V **(4 Hours)**

Risk Assessment

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategiesfor Survival.

MODULE-VI **(4 Hours)**

Disaster Mitigation

Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation In India.

Text / Reference Books:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies, NewRoyal book Company.
2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall OfIndia, New Delhi.
3. Goel S. L. , Disaster Administration And Management Text And Case Studies" ,Deep &Deep Publication Pvt. Ltd., New Delhi.

AHM102	Sanskrit for Technical Knowledge	2-0-0	Credits 0

Course Objectives:

1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. Learning of Sanskrit to improve brain functioning
3. Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power
4. The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature

MODULE-I **(8 Hours)**

- Alphabets in Sanskrit
- Past/Present/Future Tense
- Simple Sentences

MODULE-II **(8 Hours)**

- Order
- Introduction of roots
- Technical information about Sanskrit Literature

MODULE-III **(8 Hours)**

- Technical concepts of Engineering-Electrical, Mechanical,Architecture, Mathematics

Suggested reading:

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

Course Output: Students will be able to

1. Understanding basic Sanskrit language
2. Ancient Sanskrit literature about science & technology can be understood
3. Being a logical language will help to develop logic in students

AHM103	Value Education	2-0-0	Credits 0

Course Objectives: Students will be able to

1. Understand value of education and self- development
2. Imbibe good values in students
3. Know about the importance of character

MODULE-I **(6 Hours)**

- Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism.
- Moral and non- moral valuation. Standards and principles.
- Value judgements

MODULE-II **(6 Hours)**

- Importance of cultivation of values.
- Sense of duty.Devotion, Self-reliance.Confidence, Concentration. Truthfulness, Cleanliness.
- Honesty, Humanity.Power of faith, National Unity.
- Patriotism.Love for nature, Discipline

MODULE-III **(6 Hours)**

- Personality and Behavior Development - Soul and Scientific attitude.
- Positive Thinking. Integrity and discipline.
- Punctuality, Love and Kindness.
- Avoid fault Thinking.
- Free from anger, Dignity of labour.
- Universal brotherhood and religious tolerance.
- True friendship.
- Happiness Vs suffering, love for truth.
- Aware of self-destructive habits.
- Association and Cooperation.
- Doing best for saving nature

MODULE-IV **(6 Hours)**

- Character and Competence –Holy books vs Blind faith.
- Self-management and Good health.
- Science of reincarnation.
- Equality, Nonviolence, Humility, Role of Women.
- All religions and same message.
- Mind your Mind, Self-control.
- Honesty, Studying effectively

Text / Reference Books

1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

Course outcomes: Students will be able to

1. Knowledge of self-development

2. Learn the importance of Human values
3. Developing the overall personality

AHM104	Constitution of India	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutionalrole and entitlement to civil and economic rights as well as the emergence of nationhood inthe early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the BolshevikRevolution in 1917 and its impact on the initial drafting of the Indian Constitution.

MODULE-I **(4 Hours)**

- **History of Making of the Indian Constitution:**

  History

  Drafting Committee, (Composition& Working)

MODULE-II **(4 Hours)**

- **Philosophy of the Indian Constitution:**

  Preamble

  Salient Features

MODULE-III **(4 Hours)**

- **Contours of Constitutional Rights & Duties:**

  Fundamental Rights

  Right to Equality

  Right to Freedom

  Right against Exploitation

  Right to Freedom of Religion

  Cultural and Educational Rights

  Right to Constitutional Remedies

  Directive Principles of State Policy

Fundamental Duties.

MODULE-IV **(4 Hours)**

- **Organs of Governance:**

  Parliament

  Composition

  Qualifications and Disqualifications

  Powers and Functions

  Executive

  President

  Governor

  Council of Ministers

  Judiciary, Appointment and Transfer of Judges, Qualifications

  Powers and Functions

MODULE-V **(4 Hours)**

- **Local Administration:**

  District's Administration head: Role and Importance,

  Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation.

  Pachayati raj: Introduction, PRI: ZilaPachayat.

  Elected officials and their roles, CEO ZilaPachayat: Position and role.

  Block level: Organizational Hierarchy (Different departments),

  Village level: Role of Elected and Appointed officials,

  Importance of grass root democracy

  Model Curriculum of Engineering & Technology PG Courses [Volume -II]

MODULE-VI **(4 Hours)**

- **Election Commission:**

  Election Commission: Role and Functioning.

  Chief Election Commissioner and Election Commissioners.

  State Election Commission: Role and Functioning.

  Institute and Bodies for the welfare of SC/ST/OBC and women.

Text / Reference Books:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Outcomes: Students will be able to:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the passage of the Hindu Code Bill of 1956.

AHM105	Pedagogy Studies	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Review existing evidence on the review topic to inform programme design and policymaking undertaken by the DfID, other agencies and researchers.
2. Identify critical evidence gaps to guide the development.

MODULE-I **(4 Hours)**

- **Introduction and Methodology:**
- Aims and rationale, Policy background, Conceptual framework and terminology
- Theories of learning, Curriculum, Teacher education.
- Conceptual framework, Research questions**.**
- Overview of methodology and Searching.

MODULE-II **(2 Hours)**

- Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries.
- Curriculum, Teacher education.

MODULE-III **(4 Hours)**

- Evidence on the effectiveness of pedagogical practices
- Methodology for the in depth stage: quality assessment of included studies.
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?
- Theory of change.
- Strength and nature of the body of evidence for effective pedagogical practices.
- Pedagogic theory and pedagogical approaches.
- Teachers' attitudes and beliefs and Pedagogic strategies.

MODULE-IV **(4 Hours)**

- Professional development: alignment with classroom practices and follow up support
- Peer support
- Support from the head teacher and the community.
- Curriculum and assessment
- Barriers to learning: limited resources and large class sizes

MODULE-V **(2 Hours)**

- **Research gaps and future directions**
- Research design
- Contexts
- Pedagogy
- Teacher education
- Curriculum and assessment
- Dissemination and research impact.

Text / Reference Books:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2):245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal ofCurriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International JournalEducational

Development, 33 (3): 272–282.

5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

Course outcomes: Students will be able to understand:

1. What pedagogical practices are being used by teachers in formal and informal classrooms indeveloping countries?
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, andwith what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

AHM106	Stress Management by Yoga	2-0-0	Credits 0

Course Objectives:

1. To achieve overall health of body and mind
2. To overcome stress

MODULE-I **(8 Hours)**

- Definitions of Eight parts of yoga. (Ashtanga)

MODULE-II **(8 Hours)**

- Yam and Niyam.

  Do`s and Don't's in life.

  i) Ahinsa, satya, astheya, bramhacharya and aparigraha

  ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

MODULE-III **(8 Hours)**

- Asan and Pranayam

  i) Various yog poses and their benefits for mind & body

  ii) Regularization of breathing techniques and its effects-Types of pranayam

Text / Reference Books:

1. 'Yogic Asanas for Group Tarining-Part-I" :Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

Course outcomes: Students will be able to:

1. Develop healthy mind in a healthy body thus improving social health also
2. Improve efficiency

AHM107	Personality Development through Life Enlightenment Skills	2-0-0	Credits 0

Course Objectives:

1. To learn to achieve the highest goal happily
2. To become a person with stable mind, pleasing personality and determination
3. To awaken wisdom in students

MODULE-I **(8 Hours)**

Neetisatakam-Holistic development of personality

- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)
- Verses- 52,53,59 (dont's)
- Verses- 71,73,75,78 (do's)

MODULE-II **(8 Hours)**

Approach to day to day work and duties.

- Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48,
- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,
- Chapter 18-Verses 45, 46, 48.

MODULE-III **(8 Hours)**

Statements of basic knowledge.

- Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68
- Chapter 12 -Verses 13, 14, 15, 16,17, 18
- Personality of Role model. Shrimad Bhagwad Geeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
- Chapter 4-Verses 18, 38,39
- Chapter18 – Verses 37,38,63

Text / Reference Books:

1. "Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

Course outcomes: Students will be able to:

1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achievethe highest goal in life
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity
3. Study of Neetishatakam will help in developing versatile personality of students.

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

M.TECH SYLLABUS for *Specialization*: THERMAL ENGINEERING

BRANCH: MECHANICAL ENGINEERING (2018-19 Admission Batch)

First Semester				Second Semester			
Theory				**Theory**			
Course Code	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**	**Course Code**	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**
	Programme Core-1	3-0-0	3		**Programme Core-3**	3-0-0	3
THC101	Thermodynamics & combustion			THC201	Advanced Heat Transfer		
	Programme Core-2	3-0-0	3		**Programme Core-4**	3-0-0	3
THC102	I.C.Engine Combustion and Pollution			THC202	Renewable Energy Sources		
	Programme Elective-1 (Any One)	3-0-0	3		**Programme Elective-3 (Any One)**	3-0-0	3
THE101	Power Plant Engineering			THE201	Design of heat Transfer equipments		
THE102	Energy system and management			THE202	computational method in thermal engineering		
THE103	Advanced Refrigeration and Air Conditioning			THE203	Alternative fuels		
	Programme Elective-2 (Any One)	3-0-0	3		**Programme Elective-4 (Any One)**	3-0-0	3
THE104	Optimization Methods in Engineering			THE204	Convective Heat Transfer		
THE105	Gas Turbines & Jet Propulsion			THE205	Measurements in Thermal Engineering		
THE106	Incompressible & Compressible Flows			THE206	Fundamentals of combustion		
					Audit Course-2 (Any One from the list of Audit Courses)	2-0-0	0
GHM101	Research Methodology & Intellectual Property Rights	2-0-0	2				
	Audit Course-1 (Any One from the list of Audit Courses)	2-0-0	0				
	Total (Theory)	**16**	**14**		**Total (Theory)**	**14**	**12**
	Practical/ Sessional				**Practical/ Sessional**		
	Lab-1	0-0-4	2		**Lab-3**	0-0-4	2
THC103	Thermal Energy systems lab			THC203	Heat Transfer lab		
	Lab-2	0-0-4	2		**Lab-4**	0-0-4	2
THJ101	Seminar			THJ201	Seminar		
				THJ202	**Mini Project with Seminar**	0-0-4	2
	Total (Practical/ Sessional)	**8**	**4**		**Total (Practical/ Sessional)**	**12**	**6**
	TOTAL	**24**	**18**		**TOTAL**	**26**	**18**
TOTAL SEMESTER CREDITS: 18				TOTAL SEMESTER CREDITS: 18			
TOTAL CUMULATIVE CREDITS: 18				TOTAL CUMULATIVE CREDITS: 36			

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

M.TECH SYLLABUS for *Specialization*: THERMAL ENGINEERING

BRANCH: MECHANICAL ENGINEERING (2018-19 Admission Batch)

Third Semester				Fourth Semester			
Theory				**Theory**			
Course Code	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**	**Course Code**	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**
	Programme Elective-5 (Any One)	3-0-0	3				
THE301	Steam Engineering						
THE302	Design of solar and wind system						
THE303	Cryogenics						
	Open Elective (Any One)	3-0-0	3				
	Business Analytics						
	Industrial Safety						
	Operations Research						
	Cost Management of Engineering Projects						
	Composite Materials						
	Waste to Energy						
	Internet of Things						
	Soft Computing						
	Project Engineering & Management						
	Start-up & Entrepreneurship Development						
	Total (Theory)	**6**	**6**		**Total (Theory)**	**0**	**0**
	Practical/ Sessional				**Practical/ Sessional**		
THJ301	Dissertation Phase-I	0-0-20	10	THJ401	Dissertation Phase-II	0-0-32	16
	Total (Practical/ Sessional)	**20**	**10**		**Total (Practical/ Sessional)**	**32**	**16**
	TOTAL	**26**	**16**		**TOTAL**	**32**	**16**
TOTAL SEMESTER CREDITS: 16				TOTAL SEMESTER CREDITS: 16			
TOTAL CUMULATIVE CREDITS: 52				TOTAL CUMULATIVE CREDITS: 68			

List of Audit course s

1. AHM101 English for Research Paper Writing
2. ACE101 Disaster Management
3. AHM102 Sanskrit for Technical Knowledge
4. AHM103 Value Education
5. AHM104 Constitution of India
6. AHM105 Pedagogy Studies
7. AHM106 Stress Management by Yoga
8. AHM107 Personality Development through Life Enlightenment Skills

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

M.TECH SYLLABUS for *Specialization*: THERMAL ENGINEERING

BRANCH: MECHANICAL ENGINEERING (2018-19 Admission Batch)

1st Semester

THC101	Thermodynamics & Combustion	3-0-0	Credits 3

Course Object:

The objective of this course is to

1. Introduce students the concept of second law of thermodynamics, entropy and availability.
2. Introduce students to fuel combustion and its application in boilers and engines; and provide students with opportunities to develop skills at handling real world assessments of engineering problems in power plants and automotive industries.

Syllabus Contents:

First law and State postulates, Second law and Entropy, Availability and Irreversibility, Transient flow analysis

Nonreactive Ideal-Gas Mixture, PvT Behavior of Real gases and Real Gas mixture Generalized Thermodynamic Relationship

Combustion and Thermo-chemistry, Second law analysis of reacting mixture, Availability analysis of reacting mixture, Chemical equilibrium

Statistical thermodynamics, statistical interpretations of first and second law and Entropy, Third law of thermodynamics, Nerst heat theorem.

References:

1. Cengel, "Thermodynamics", Tata McGraw Hill Co., New Delhi, 1980.
2. Howell and Dedcius, "Fundamentals of Engineering Thermodynamics", McGraw Hill Inc., U.S.A.
3. Van Wylen & Sonntag, "Thermodynamics", John Wiley and Sons Inc., U.S.A.
4. Jones and Hawkings, "Engineering Thermodynamics", John Wiley and Sons Inc., U.S.A, 2004.
5. Holman, "Thermodynamics", McGraw Hill Inc., New York, 2002.
6. Faires V.M. and Simmag, "Thermodynamics", Macmillan Publishing Co. Inc., U.S.A.
7. Rao Y.V.C., "Postulational and Statistical Thermodynamics", Allied Publishers Inc, 1994.

Course Outcomes:

1. Student will get Knowledge of exergy, basic laws governing energy conversion in multi-component systems and application of chemical thermodynamics.
2. Student will be aware about advanced concepts in thermodynamics with emphasis on thermodynamic relations, equilibrium and stability of multiphase multi-component systems.
3. Student will be aware about the molecular basis of thermodynamics.

4. Student should apply the fundamental principles of thermodynamics to non-ideal models of numerous engineering devices.

THC102	I.C.Engine Combustion and Pollution	3-0-0	Credits 3

Course Objective:

1. To make students familiar with the design and operating characteristics of modern internal combustion engines
2. To apply analytical techniques to the engineering problems and performance analysis of internal combustion engines
3. To study the thermodynamics, combustion, heat transfer, friction and other factors affecting engine power, efficiency and emissions
4. To introduce students to the environmental and fuel economy challenges facing the internal combustion engine
5. To introduce students to future internal combustion engine technology and market trends.
6. To introduce students the different type of emission from SI and CI engine and give idea to reduce the harmful emission

Syllabus Contents:

Role of fuel in engine combustion, selection of fuels, Basic combustion processes for SI and CI engines

Factors affecting combustion in these engines – Combustion chambers – Instrumentation to study the combustion process in engines.

Pollution formation in SI and CI engines – Factors affecting emissions

Control measures for evaporative emission – Thermal reactors and catalytic converters – Engine modifications to reduce emissions

Instrumentation to measure pollutants – Emission standards and testing.

References:

1. J.B. Heywood, Internal Combustion Engine Fundamentals, McGraw Hill International Editions, 1989.
2. B. P. Pundir, Engine Emissions: Pollutant Formation and Advances in Control Technology, Narosa Publishing House, New Delhi, 2007.
3. Handbook of Air Pollution from Internal Combustion Engines: Pollutant Formation and Control, Ed. Eran Sher, Academic Press, 1998.

Course Outcomes:

1. Differentiate among different internal combustion engine designs
2. Recognize and understand reasons for differences among operating characteristics of different engine

types and designs

3. Given an engine design specification, predict performance and fuel economy trends with good accuracy
4. Based on an in-depth analysis of the combustion process, predict concentrations of primary exhaust pollutants
5. Exposure to the engineering systems needed to set-up and run engines in controlled laboratory environments
6. Develop skills to run engine dynamometer experiments
7. Learn to compare and contrast experimental results with theoretical trends, and to attribute observed discrepancies to either measurement error or modeling limitations
8. Develop an understanding of real world engine design issues
9. Develop an ability to optimize future engine designs for specific sets of constraints (fuel economy, performance, emissions)
10. Through the use of both theoretical techniques and experimentation, develop an appreciation for theoretical and practical limits to engine performance and fuel economy

THE101	Power Plant Engineering	3-0-0	Credits 3

Course Objective:

1. Basic knowledge of Different types of Power Plants, site selection criteria of each one of them.
2. Understanding of Thermal Power Plant Operation, turbine governing, different types of high pressure boilers including supercritical and supercharged boilers, Fluidized bed combustion systems.
3. Design of chimney in thermal power plants, knowledge of cooling tower operation, numerical on surface condenser design.
4. Basic knowledge of Different types of Nuclear power plants including Pressurized water reactor, Boiling water reactor, gas cooled reactor, liquid metal fast breeder reactor.
5. Understanding of Power Plant Economics, Energy Storage including compressed air energy and pumped hydro etc.
6. Discussing environmental and safety aspects of power plant operation

Syllabus Contents:

Introduction: Energy resources and their availability, types of power plants, selection of the plants,review of basic thermodynamic cycles used in power plants.

Hydro Electric Power Plants: Rainfall and run-off measurements and plotting of variouscurves for estimating stream flow and size of reservoir, power plants design, construction and operation of different components of hydro-electric power plants, site selection, comparison with other types of power plants.

Steam Power Plants: Flow sheet and working of modern-thermal power plants, super criticalpressure steam stations, site selection, coal storage, preparation, coal handling systems, feeding and burning of pulverized

fuel, ash handling systems, dust collection-mechanical dust collector and electrostatic precipitator.

Steam generators and their accessories: High pressure Boilers, Accessories, Fluidized bedboiler.

Condensers: Direct Contact Condenser, Surface Condensers, Effect of various parameters oncondenser performance, Design of condensers, Cooling towers and cooling ponds

Combined Cycles: Constant pressure gas turbine power plants, Arrangements of combined plants (steam & gas turbine power plants), re-powering systems with gas production from coal, using PFBC systems, with organic fluids, parameters affecting thermodynamic efficiency of combined cycles.

Nuclear Power Plants: Principles of nuclear energy, basic nuclear reactions, nuclearreactors PWR, BWR, CANDU, Sodium graphite, fast breeder, homogeneous; gas cooled. Advantagesandlimitations, nuclear power station, waste disposal.

Power Plant Economics: load curve, different terms and definitions, cost of electricalenergy, tariffs methods of electrical energy, performance & operating characteristics of power plants- incremental rate theory, input-output curves, efficiency, heat rate, economic load sharing, Problems.

References:

1. Power plant engineering by 'Arrora&Domkundwar', DhanpatRai& Sons, New Delhi, 2008.
2. Power plant Technology by 'M.M.Ei-Wakil', McGraw Hill Com., 1985.
3. Power plant engineering by 'P C Sharma', S.K. Kataria& Sons, New Delhi, 2010.

Course Outcomes:

1. Student will be able to understand analytical and technological aspects of power plant design, systems and their effects.
2. Student could describe the working of power plants based on type of fuel.
3. Student could explain the working of the hydro electric power plants.
4. Student could analyse economic feasibility and its implications on power generating units.

1.			

THE102	Energy System and Management	3-0-0	Credits 3

Course Objectives:

1. Solve basic power flow equations by incorporating engineering constraints in power networks
2. Apply mathematical models to analyze the operation and economics of wholesale electricity markets
3. Identify the opportunity and challenges brought by renewable energy integration

Syllabus Contents:

Introduction to Thermodynamics, Fluid Flow and Heat Transfer

Heat transfer media: Water, steam, Thermal fluids, Air-water vapor mixtures

Heat transfer equipment: Heat exchangers, Steam plant

Energy storage systems: Thermal energy storage methods, Energy saving, Thermal energystorage systems

Energy conversion systems: Furnaces, turbines

Heat recovery systems: Incinerators, regenerators and boilers

Energy Management: Principles of Energy Management, Energy demand estimation, Organizingand Managing Energy Management Programs, Energy pricing

Energy Audit: Purpose, Methodology with respect to process Industries, Characteristic methodemployed in Certain Energy Intensive Industries

Economic Analysis: Scope, Characterization of an Investment ProjectCase studies.

References:

1. Turner, W. C., Doty, S. and Truner, W. C., Energy Management Hand book, 7th edition, Fairmont Press, 2009.
2. De, B. K., Energy Management audit & Conservation, 2nd Edition, Vrinda Publication, 2010.
3. Murphy, W. R., Energy Management, Elsevier, 2007.
4. Smith, C. B., Energy Management Principles, Pergamon Press, 2007.

Course Outcomes:

2. Explain the fundamentals of energy management and its influence on environment
3. Describe methods of energy production for improved utilization.
4. Apply the principles of thermal engineering and energy management to improve the performance of thermal systems.
5. Analyze the methods of energy conservation and energy efficiency for buildings, air conditioning, heat recovery and thermal energy storage systems.

THE103	Advanced Refrigeration and Air Conditioning	3-0-0	Credits 3

The objectives of this course are to:

1. Introduce students to basic use of Psychrometrics chart for Refrigerating and Air- Conditioning systems
2. Provide students with opportunities to develop their knowledge of Refrigerating and Air- Conditioning systems design.

Syllabus Contents:

Refrigeration cycles – analysis: Development of Vapor Compression Refrigeration Cycle fromReverse Carnot Cycle- conditions for high COP-deviations from ideal vapor compression cycle, Multipressure Systems, Cascade Systems-Analysis.

Main system components: Compressor- Types, performance, Characteristics of Reciprocating Compressors, Capacity Control, Types of Evaporators & Condensers and their functional aspects, Expansion Devices and their Behaviour with fluctuating load.

Refrigerants: Classification of Refrigerants, Refrigerant properties, Oil Compatibility, EnvironmentalImpact-Montreal/ Kyoto protocols-Eco Friendly Refrigerants. Different Types of Refrigeration Tools, Evacuation and Charging Unit, Recovery and Recycling Unit, Vacuum Pumps.

Other refrigeration cycles: Vapor Absorption Systems-Aqua Ammonia &LiBr Systems, Steam JetRefrigeration Thermo Electric Refrigeration, Air Refrigeration cycles.

Psychrometry: Moist Air properties , use of Psychrometric Chart , Various Psychrometricprocesses , Air Washer , Adiabatic Saturation.

Summer and winter air conditioning:

Air conditioning processes-RSHF, summer Air conditioning, Winter Air conditioning, Bypass Factor. Applications with specified ventilation air quantity- Use of ERSHF, Application with low latent heat loads and high latent heat loads.

Load estimation & air conditioning control: Solar Radiation-Heat Gain through Glasses, Heattransfer through roofs and walls, Total Cooling Load Estimation. Controls of Temperature, Humidity and Air flow.

Air distribution: Flow through Ducts , Static & Dynamic Losses , Air outlets , Duct Design–Equal,Friction Method , Duct Balancing , Indoor Air Quality , Thermal Insulation , Fans & Duct System Characteristics , Fan Arrangement Variable Air Volume systems , Air Handling Units and Fan Coil units.

References:

1. Roy J. Dossat, Principles of Refrigeration, Wiley Limited
2. Arora C.P., Refrigeration and Air-conditioning, Tata McGraw –Hill, New Delhi
3. Stoecker W.F., and Jones J.W., Refrigeration and Air-conditioning, McGraw - Hill, New Delhi

Data Books:

1. Refrigerant and Psychometric Properties (Tables & Charts) SI Units, MathurM.L. & Mehta F.S., Jain Brothers.

Course Outcomes:

1. Understand physical and mathematical aspects of refrigeration and air- conditioning systems.
2. Apply theoretical and mathematical principles to simple, complex vapour compression and vapour absorption refrigeration systems.
3. Understand conventional and alternate refrigerants and their impact on environment.
4. Design air-conditioning systems.

THE104	Optimization Methods in Engineering	3-0-0	Credits 3

Course Object:

Introduce methods of optimization to engineering students, including linear programming, network flow algorithms, integer programming, interior point methods, quadratic programming, nonlinear programming, and heuristic methods. Numerous applications are presented in civil, environmental, electrical (control) engineering, and industrial engineering. The goal is to maintain a balance between theory, numerical computation, problem setup for solution by optimization software, and applications to engineering systems.

Syllabus Contents:

Introduction to the course: Statement of an optimization problem and classification of optimizationproblems.

Optimization Techniques: Single-Variable Optimization, Multivariable Optimization without anyConstraints, with Equality and Inequality Constraints.

Linear Programming: Simplex Methods, Sensitivity Analysis, Transportation Problem

Integer Programming: Graphical Representation, Integer Polynomial Programming

Geometric Programming: Formulation and Solutions of Unconstrained and Constrained geometricprogramming problem.

Dynamic Programming: Multistage Decision Processes

One-Dimensional Minimization Methods: Elimination methods: Fibonacci Method, Golden

Section Method, Interpolation methods: Quadratic Interpolation Method, Cubic Interpolation Method

Unconstrained Optimization Techniques: Univariate, Conjugate Gradient Method and VariableMetric Method.

Constrained Optimization Techniques: Characteristics of a constrained problem; Direct Methodof feasible directions; Indirect Method of interior and exterior penalty functions.

References:

1. Rao, S. S., Optimization Theory and Applications, Wiley Eastern Ltd., 2nd Edition, 2004.
2. Fox, R. L., Optimization Methods for Engineering Design, Addison Wesley, 2001.

Course Outcomes:

1. Explain an overview of modelling of constrained decision making.
2. Develope a mathematical model for a given problem.
3. Solve practical problems using suitable optimization technique.
4. Analyze the sensitivity of a solution to different variables.

THE105	Gas Turbines & Jet Propulsion	3-0-0	Credits 3

Course Objective:

1. Students will establish understanding of propulsion systems in aircraft that are essential to graduate engineers who are intended to work in aircraft system/component manufacturing/maintenance environments.
2. Students should be able to describe and appreciate the key aeronautical engineering features of the context in which the relevant industry operates.

Syllabus Contents:

Introduction: Classification of Turbomachines, Applications of Gas Turbines, Assumptions for Air-Standard Cycles, Simple Brayton Cycle, Heat Exchange Cycle, Inter-cooling and Reheating Cycle, Comparison of Various Cycles.

Ideal Shaft Power Cycles and their Analysis: Assumptions for Air-Standard Cycles, Simple Brayton Cycle, Heat Exchange Cycle, Inter-cooling and Reheating Cycle, Comparison of Various Cycles.

Real Cycles and their Analysis: Methods of Accounting for Component Losses, Isentropic andPolytropic Efficiencies, Transmission and Combustion Efficiencies, Comparative Performance of Practical Cycles, Combined Cycles and Cogeneration Schemes.

Jet Propulsion Cycles and their Analysis: Criteria of Performance, Simple Turbojet Engine,Simple Turbofan

Engine, Simple Turboprop Engine, Turbo-shaft Engine, Thrust Augmentation Techniques

Fundamentals of Rotating Machines: General Fluid Dynamic Analysis, Euler's Energy Equation, Components of Energy Transfer, Impulse and Reaction Machines.

Centrifugal Compressors: Construction and Principle of Operation, Elementary Theory andVelocity Triangles, Factors Effecting Stage Pressure Ratio, The Diffuser, The Compressibility Effects, Pre-rotation and Slip Factor, Surging and Choking, Performance Characteristics.

Flow Through Cascades: Cascade of Blades, Axial Compressor Cascades, Lift and Drag Forces, Cascade Efficiency, Cascade Tunnel.

Axial Flow Compressors: Construction and Principle of Operation, Elementary Theory andVelocity Triangles, Factors Effecting Stage Pressure Ratio, Degree of Reaction, Work done factor, Three Dimensional Flow, Design Process, Blade Design, Stage Performance, Compressibility Effects, Off-Design Performance.

Combustion System: Operational Requirements, Classification of Combustion Chambers, Factors Effecting Combustion Chamber Design, The Combustion Process, Flame Stabilization, Combustion Chamber Performance, Some Practical Problems Gas Turbine Emissions.

Axial and Radial Flow Turbines: Construction and Operation, Vortex Theory, Estimation of StagePerformance, Overall Turbine Performance, Turbine Blade Cooling, The Radial Flow Turbine.

Off-Design Performance: Off-Design Performance of Single Shaft Gas Turbine, Off-DesignPerformance of Free Turbine Engine, Off-Design Performance of the Jet Engine, Methods of Displacing the Equilibrium Running Line

References:

1. Sarvanamuttoo, H.I.H., Rogers, G. F. C. and Cohen, H., *Gas Turbine Theory*, 6th Edition, Pearson Prentice Hall, 2008.
2. Dixon, S.L., *Fluid Mechanics and Thermodynamics of Turbomachinery*, 7th Edition, Elsevier, 2014.
3. Flack, R.D., *Fundamentals of Jet Propulsion with Applications*, Cambridge University Press, 2011.
4. Ganesan, V., *Gas Turbines*, 3rd Edition, Tata McGraw Hill, 2010.
5. Yahya, S. M., *Turbines, Compressors and Fans*, 4th Edition, Tata McGraw Hill, 2010. Lefebvre, A.H., *Gas Turbine Combustion,* CRC Press, 2010.

Course Outcomes:

1. Understand the ideal and real thermodynamic cycles of air-breathing engines and Industrial gas turbines.

2. Design the blading, study the velocity triangles and estimate the performance of centrifugal and axial flow compressors.
3. Understand the combustion process and design the combustion chamber of a gas Turbine.
4. Design the blading, study the velocity triangles and estimate the performance of axial and radial in-flow turbines.

THE106	Incompressible & Compressible Flows	3-0-0	Credits 3

Course Objective

1. To teach students the basic concepts and analytical tools of compressible fluids, and how to apply them in practice.
2. To provide students with a firm understanding of the key physical phenomena involved under compressible flow conditions, and how these result from the governing thermodynamic and conservation principles.
3. To teach students the essential concepts and analytical methods involved in one- and two dimensional compressible flows, and how to apply these to practical problems. The course will start from the fundamental equations of fluid mechanics and take on to the broader classification of incompressible and compressible flows. By getting the crisp and useful idea of incompressible flows, extensive investigations will be marched into the area of compressible flow regime.

Syllabus Content:

Introduction: Introduction to Fluid Mechanics-Properties of Fluids

Fluid Statics: Fluid Statics, Fundamental Equations-Applications of Fundamental Equations,Relative Motion of Liquids

Kinematics of Fluids: Kinematics of Fluids- Review of basics-Velocity potential, Stream functionand Vorticity.

Theory of Stress and Rate of Strain: General theory of Stress and Rate of Strain FundamentalEquations – Integral form-Fundamental Equations – Integral form-Reynolds Transport Theorem-Applications of the Integral Form of Equations-Numerical.

Fundamental Equations in Differential Form: Fundamental: Equations in Differential Form-One-dimensional Inviscid Incompressible Flow-Euler's Equation and Bernoulli's Equation-Applications of the Bernoulli's Equations-Numerical.

Two and Three – dimensional Inviscid Incompressible Flow: Two and Three–dimensionalInviscid Incompressible Flow-Laminar Flow- Flow between Parallel Flat plates-Steady Flow in Pipes-Applications of Laminar Flow-Numericals.

The Laminar Boundary layer: The Laminar Boundary layer– Prandtl's Boundary Layer Equations-The Boundary layer along a Flat Plate-Solution to the Boundary Layer Equations-Momentum Integral Equation-Separation of Boundary Layer and Control-Numericals

Turbulent Flow: Introduction to Turbulent Flow–Modified N-S Equations-Semi - empiricalTheories-Turbulent Boundary Layer-Numericals

Dimensional Analysis: Flow over a bluff body–Lift and Drag-Dimensional Analysis and Similitude.

Introduction to Compressible Flow: Introduction to Compressible Flow–review of Fundamentals-Stagnation Properties – Relations and Tables-Numericals

Wave Motion: Wave Motion-Propagation of Motion in Compressible Fluids-Mach number and MachCone-Numericals

Isentropic Flow: Isentropic Flow Relations-Flow through Nozzles and Diffusers-Isentropic FlowRelations and Tables-Numericals

Flow across Normal Shock and Oblique Shock: Basic Equations Normal Shock–Prandtl-MeyerEquation, Oblique shock-Property variation – Relations and Tables-Numericals.

Flow through a constant area duct with Friction: Flow through a constant area duct with Friction-Fanno Line, Fanno Flow -Variation of Properties – Relations and Tables-Numericals. Flow through a constant area duct with Heat Transfer-Flow through a constant area duct with Heat Transfer-Rayleigh Line, Rayleigh Flow – Variation of Properties – Relations and Tables-Numericals.

References:

1. S.W. Yuan ., *Foundations of Fluid Mechanics*, Prentice Hall of India, 2000
2. S.M. Yahya , *Fundamentals of Compressible Flow, with Aircraft and Rocket Propulsion*, 4th edition, New Age techno, 2010
3. Schlichting, H., *Boundary Layer Theory*, 8th edition, Springer, 2004.
4. White F.M., *Viscous Fluid Flow*, 3rd edition, Tata McGraw Hill Book Company, 2011.

Outcomes:

Ability to

1. distinguish between various flow regimes
2. analyse the flow under different flow conditions
3. assess the flow behavior and consequent loads due to flow Fluid Dynamics

THC103	Thermal Energy Systems lab	0-0-4	Credits 2

List of Experiments:

1. Experimental study of premixed and diffusion flame.
2. Determination of calorific value of a fuel using bomb calorimeter.
3. Study of multi-point fuel injection system.
4. Combustion analysis of an I.C. Engine.
5. Performance test of an I.C. Engine (Diesel).
6. Emission test of Petrol Engine.

7. Emission test of Diesel Engine.
8. Testing of three way catalytic converter.
9. Performance test of an I.C. Engine (Petrol).
10. Performance test of variable compression ratio I.C. Engine.

GHM101	Research Methodology & Intellectual Property Rights	2-0-0	Credits 2

MODULE-I **(06 Hours)**

Meaning of research problem, Sources of research problem, Criteria characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.

Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

MODULE-II **(04 Hours)**

Effective literature studies approaches, analysis,

Plagiarism, Research ethics.

MODULE-III **(04 Hours)**

Effective technical writing, how to write report, Paper.

Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

MODULE-IV **(06 Hours)**

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

MODULE-V **(04 Hours)**

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

MODULE-VI **(04 Hours)**

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Text/Reference Books:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science& engineering students'".
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.
5. Mayall, "Industrial Design", McGraw Hill, 1992.
6. Niebel, "Product Design", McGraw Hill, 1974.
7. Asimov, "Introduction to Design", Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016.
9. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

Course Outcomes: At the end of the course, students will be able to

1. Understand research problem formulation.
2. Analyze research related information
3. Follow research ethics
4. Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property.

   Right to be promoted among students in general & engineering in particular.
6. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Audit Courses

AHM101	English for Research Paper Writing	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Understand that how to improve your writing skills and level of readability
2. Learn about what to write in each section
3. Understand the skills needed when writing a Title

   Ensure the good quality of paper at very first-time submission

MODULE-I **(4 Hours)**

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

MODULE-II **(4 Hours)**

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction.

MODULE-III **(4 Hours)**

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

MODULE-IV **(4 Hours)**

key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed whenwriting a Review of the Literature.

MODULE-V **(4 Hours)**

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions.

MODULE-VI **(4 Hours)**

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

Suggested Studies:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book.

4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

ACE101	Disaster Management	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

MODULE-I **(4 Hours)**

Introduction

Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

MODULE-II **(4 Hours)**

Repercussions of Disasters and Hazards:

Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem.

Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

MODULE-III **(4 Hours)**

Disaster Prone Areas In India

Study of Seismic Zones; Areas Prone To Floods And Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics

MODULE-IV **(4 Hours)**

Disaster Preparedness and Management

Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data From Meteorological and Other Agencies, Media Reports: Governmental and

Community Preparedness.

MODULE-V **(4 Hours)**

Risk Assessment

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategiesfor Survival.

MODULE-VI **(4 Hours)**

Disaster Mitigation

Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation In India.

Text / Reference Books:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies, New Royal book Company.
2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences and Reflections", Prentice Hall OfIndia, New Delhi.
3. Goel S. L., Disaster Administration And Management Text And Case Studies", Deep &Deep Publication Pvt. Ltd., New Delhi.

AHM102	Sanskrit for Technical Knowledge	2-0-0	Credits 0

Course Objectives:

1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. Learning of Sanskrit to improve brain functioning
3. Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power
4. The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature

MODULE-I **(8 Hours)**

- Alphabets in Sanskrit
- Past/Present/Future Tense
- Simple Sentences

MODULE-II **(8 Hours)**

- Order
- Introduction of roots
- Technical information about Sanskrit Literature

MODULE-III **(8 Hours)**

- Technical concepts of Engineering-Electrical, Mechanical,Architecture, Mathematics

Suggested reading:

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

Course Output: Students will be able to

1. Understanding basic Sanskrit language
2. Ancient Sanskrit literature about science & technology can be understood
3. Being a logical language will help to develop logic in students

AHM103	Value Education	2-0-0	Credits 0

Course Objectives: Students will be able to

1. Understand value of education and self- development
2. Imbibe good values in students
3. Know about the importance of character

MODULE-I **(6 Hours)**

- Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism.
- Moral and non- moral valuation. Standards and principles.
- Value judgements

MODULE-II **(6 Hours)**

- Importance of cultivation of values.
- Sense of duty.Devotion, Self-reliance.Confidence, Concentration. Truthfulness, Cleanliness.
- Honesty, Humanity.Power of faith, National Unity.
- Patriotism.Love for nature, Discipline

MODULE-III **(6 Hours)**

- Personality and Behavior Development - Soul and Scientific attitude.
- Positive Thinking. Integrity and discipline.
- Punctuality, Love and Kindness.
- Avoid fault Thinking.
- Free from anger, Dignity of labour.
- Universal brotherhood and religious tolerance.
- True friendship.
- Happiness Vs suffering, love for truth.
- Aware of self-destructive habits.
- Association and Cooperation.
- Doing best for saving nature

MODULE-IV **(6 Hours)**

- Character and Competence –Holy books vs Blind faith.
- Self-management and Good health.
- Science of reincarnation.
- Equality, Nonviolence, Humility, Role of Women.
- All religions and same message.
- Mind your Mind, Self-control.
- Honesty, Studying effectively

Text / Reference Books

1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

Course outcomes: Students will be able to

1. Knowledge of self-development

2. Learn the importance of Human values
3. Developing the overall personality

AHM104	Constitution of India	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutionalrole and entitlement to civil and economic rights as well as the emergence of nationhood inthe early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the BolshevikRevolution in 1917 and its impact on the initial drafting of the Indian Constitution.

MODULE-I **(4 Hours)**

- **History of Making of the Indian Constitution:**

  History

  Drafting Committee, (Composition& Working)

MODULE-II **(4 Hours)**

- **Philosophy of the Indian Constitution:**

  Preamble

  Salient Features

MODULE-III **(4 Hours)**

- **Contours of Constitutional Rights & Duties:**

  Fundamental Rights

  Right to Equality

  Right to Freedom

  Right against Exploitation

  Right to Freedom of Religion

  Cultural and Educational Rights

  Right to Constitutional Remedies

  Directive Principles of State Policy

Fundamental Duties.

MODULE-IV **(4 Hours)**

- **Organs of Governance:**

  Parliament

  Composition

  Qualifications and Disqualifications

  Powers and Functions

  Executive

  President

  Governor

  Council of Ministers

  Judiciary, Appointment and Transfer of Judges, Qualifications

  Powers and Functions

MODULE-V **(4 Hours)**

- **Local Administration:**

  District's Administration head: Role and Importance,

  Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation.

  Pachayati raj: Introduction, PRI: ZilaPachayat.

  Elected officials and their roles, CEO ZilaPachayat: Position and role.

  Block level: Organizational Hierarchy (Different departments),

  Village level: Role of Elected and Appointed officials,

  Importance of grass root democracy

  Model Curriculum of Engineering & Technology PG Courses [Volume -II]

MODULE-VI **(4 Hours)**

- **Election Commission:**

  Election Commission: Role and Functioning.

  Chief Election Commissioner and Election Commissioners.

  State Election Commission: Role and Functioning.

  Institute and Bodies for the welfare of SC/ST/OBC and women.

Text / Reference Books:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Outcomes: Students will be able to:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the passage of the Hindu Code Bill of 1956.

AHM105	Pedagogy Studies	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Review existing evidence on the review topic to inform programme design and policymaking undertaken by the DfID, other agencies and researchers.
2. Identify critical evidence gaps to guide the development.

MODULE-I **(4 Hours)**

- **Introduction and Methodology:**
- Aims and rationale, Policy background, Conceptual framework and terminology
- Theories of learning, Curriculum, Teacher education.
- Conceptual framework, Research questions**.**
- Overview of methodology and Searching.

MODULE-II **(2 Hours)**

- Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries.
- Curriculum, Teacher education.

MODULE-III **(4 Hours)**

- Evidence on the effectiveness of pedagogical practices
- Methodology for the in depth stage: quality assessment of included studies.
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?
- Theory of change.
- Strength and nature of the body of evidence for effective pedagogical practices.
- Pedagogic theory and pedagogical approaches.
- Teachers' attitudes and beliefs and Pedagogic strategies.

MODULE-IV **(4 Hours)**

- Professional development: alignment with classroom practices and follow up support
- Peer support
- Support from the head teacher and the community.
- Curriculum and assessment
- Barriers to learning: limited resources and large class sizes

MODULE-V **(2 Hours)**

- **Research gaps and future directions**
- Research design
- Contexts
- Pedagogy
- Teacher education
- Curriculum and assessment
- Dissemination and research impact.

Text / Reference Books:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2):245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International JournalEducational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford

and Boston: Blackwell.

6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

Course outcomes: Students will be able to understand:

1. What pedagogical practices are being used by teachers in formal and informal classrooms indeveloping countries?
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, andwith what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

AHM106	Stress Management by Yoga	2-0-0	Credits 0

Course Objectives:

1. To achieve overall health of body and mind
2. To overcome stress

MODULE-I **(8 Hours)**

- Definitions of Eight parts of yoga. (Ashtanga)

MODULE-II **(8 Hours)**

- Yam and Niyam.

  Do`s and Don't's in life.

  i) Ahinsa, satya, astheya, bramhacharya and aparigraha

  ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

MODULE-III **(8 Hours)**

- Asan and Pranayam

  i) Various yog poses and their benefits for mind & body

  ii) Regularization of breathing techniques and its effects-Types of pranayam

Text / Reference Books:

1. 'Yogic Asanas for Group Tarining-Part-I" :Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

Course outcomes: Students will be able to:

1. Develop healthy mind in a healthy body thus improving social health also
2. Improve efficiency

AHM107	Personality Development through Life Enlightenment Skills	2-0-0	Credits 0

Course Objectives:

1. To learn to achieve the highest goal happily
2. To become a person with stable mind, pleasing personality and determination
3. To awaken wisdom in students

MODULE-I **(8 Hours)**

Neetisatakam-Holistic development of personality

- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)
- Verses- 52,53,59 (dont's)
- Verses- 71,73,75,78 (do's)

MODULE-II **(8 Hours)**

Approach to day to day work and duties.

- Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48,
- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,
- Chapter 18-Verses 45, 46, 48.

MODULE-III **(8 Hours)**

Statements of basic knowledge.

- Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68

- Chapter 12 -Verses 13, 14, 15, 16,17, 18
- Personality of Role model. Shrimad Bhagwad Geeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
- Chapter 4-Verses 18, 38,39
- Chapter18 – Verses 37,38,63

Text / Reference Books:

1. "Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

Course outcomes: Students will be able to:

1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achievethe highest goal in life
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity
3. Study of Neetishatakam will help in developing versatile personality of students.

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

M.TECH SYLLABUS for *Specialization*: METALLURGICAL AND MATERIALS ENGINEERING

BRANCH: METALLURGICAL AND MATERIALS ENGINEERING (2018-19 Admission Batch)

First Semester				Second Semester			
Theory				**Theory**			
Course Code	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**	**Course Code**	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**
	Programme Core-1	3-0-0	3		**Programme Core-3**	3-0-0	3
MMC101	Advanced Physical Metallurgy			MMC201	Mechanical Behaviour of Materials		
	Programme Core-2	3-0-0	3		**Programme Core-4**	3-0-0	3
MMC102	Advanced Metallurgical Thermodynamics and Kinetics			MMC202	Characterization of Materials		
	Programme Elective-1 (Any One)	3-0-0	3		**Programme Elective-3 (Any One)**	3-0-0	3
MME101	Solid State Phase Transformation			MME201	Biomaterials		
MME102	Solidification of Metals and Alloys			MME202	Nano Materials		
MME103	Transport Phenomena in Metallurgy			MME203	Principles of Electronic Materials		
	Programme Elective-2 (Any One)	3-0-0	3		**Programme Elective-4 (Any One)**	3-0-0	3
MME104	Advanced Ferrous Production Technology			MME204	Degradation of Materials		
MME105	Diffusion in Materials			MME205	Material Failure and Analysis		
MME106	Engineering Composites			MME206	Tribology of Materials		
					Audit Course-2 (Any One from the list of Audit Courses)	2-0-0	0
GHM101	Research Methodology & Intellectual Property Rights	2-0-0	2				
	Audit Course-1 (Any One from the list of Audit Courses)	2-0-0	0				
	Total (Theory)	**16**	**14**		**Total (Theory)**	**14**	**12**
	Practical/ Sessional				**Practical/ Sessional**		
	Lab-1	0-0-4	2		**Lab-3**	0-0-4	2
MMC103	Physical Metallurgy and Metallography Lab			MMC203	Materials Testing Lab.		
	Lab-2	0-0-4	2		**Lab-4**	0-0-4	2
MMC104	Metallurgical Thermodynamics Lab.			MMC204	Advanced Materials Processing Lab		
				MMJ201	**Mini Project with Seminar**	0-0-4	2
	Total (Practical/ Sessional)	**8**	**4**		**Total (Practical/ Sessional)**	**12**	**6**
	TOTAL	**24**	**18**		**TOTAL**	**26**	**18**
TOTAL SEMESTER CREDITS: 18				TOTAL SEMESTER CREDITS: 18			
TOTAL CUMULATIVE CREDITS: 18				TOTAL CUMULATIVE CREDITS: 36			

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

M.TECH SYLLABUS for *Specialization*: METALLURGICAL AND MATERIALS ENGINEERING

BRANCH: METALLURGICAL AND MATERIALS ENGINEERING (2018-19 Admission Batch)

Third Semester				Fourth Semester			
Theory				**Theory**			
Course Code	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**	**Course Code**	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**
	Programme Elective-5 (Any One)	3-0-0	3				
MME301	Modelling and Computer Application in Metallurgy						
MME302	Physics of Materials						
MME303	Energy conservation and pollution control in Metallurgical Industries						
	Open Elective (Any One)	3-0-0	3				
	Business Analytics						
	Industrial Safety						
	Operations Research						
	Cost Management of Engineering Projects						
	Composite Materials						
	Waste to Energy						
	Internet of Things						
	Soft Computing						
	Project Engineering & Management						
	Start-up & Entrepreneurship Development						
	Total (Theory)	**6**	**6**		**Total (Theory)**	**0**	**0**
	Practical/ Sessional				**Practical/ Sessional**		
MMJ301	Dissertation Phase-I	0-0-20	10	MMJ401	Dissertation Phase-II	0-0-32	16
	Total (Practical/ Sessional)	**20**	**10**		**Total (Practical/ Sessional)**	**32**	**16**
	TOTAL	**26**	**16**		**TOTAL**	**32**	**16**
TOTAL SEMESTER CREDITS: 16				TOTAL SEMESTER CREDITS: 16			
TOTAL CUMULATIVE CREDITS: 52				TOTAL CUMULATIVE CREDITS: 68			

List of Audit courses

1. AHM101 English for Research Paper Writing
2. ACE101 Disaster Management
3. AHM102 Sanskrit for Technical Knowledge
4. AHM103 Value Education
5. AHM104 Constitution of India
6. AHM105 Pedagogy Studies
7. AHM106 Stress Management by Yoga
8. AHM107 Personality Development through Life Enlightenment Skills

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

M.TECH SYLLABUS for *Specialization*: METALLURGICAL AND MATERIALS ENGINEERING

BRANCH: METALLURGICAL AND MATERIALS ENGINEERING (2018-19 Admission Batch)

1st Semester

MMC101	Advanced Physical Metallurgy	3-0-0	Credits 3

Objectives of the course: To develop an understanding of the basic principles of physical metallurgy and apply those principles to engineering applications.

MODULE-I **(14 Hours)**

Characteristic property of the metals , bonding in solids, primary bonds like ionic ,covalent and metallic bond, crystal systems, common crystal structure of metals , representation of planes and directions in crystals, atomic packing in crystals, calculation of packing density, voids in common crystal structures and imperfection in crystals.

Solidification of pure metals, homogenous and heterogeneous nucleation process, cooling curve, concept of supercooling, microstructure of pure metals, solidification of metals in ingot mould.

MODULE-II **(14 Hours)**

Concept of plastic deformation of metals, critical resolve shear stress, dislocation theory, deformation by slip and twin , plastic deformation in polycrystalline metals, yield point phenomenon and related effects, concept of cold working, ,preferred orientation, annealing: recovery, recrystalization, and grain growth, hot working

Concept of alloy formation, types of alloys, solid solutions factors governing solid solubility viz. size factor, valency factor, crystal structure factor and chemical affinity factor, order –disorder transformation

MODULE-III **(14 Hours)**

Binary phase diagrams, isomorphous system, eutectic system, peritectic system, eutectoid system, and peritectiod system. Allotropic transformation lever rule and its application interpretation of solidification behaviour and microstructure of different alloys belonging to those systems, effect of non-equilibrium cooling, coring and homogenization.

Iron –cementite and iron –graphite phase diagrams, microstructure and properties of different alloys (both steels and cast iron), types of cast iron , their microstructure and typical uses

TTT diagram concept of heat treatment of steel i.e. annealing, normalizing, hardening and tempering microstructural effects brought about by these processes and their influences on mechanical properties

Effect of common alloying elements on the equilibrium and TTT diagrams, concepts of hardenability factors affecting hardenabilty.

Text/Reference Books:

1. Reedhill R.E., Physical Metallurgy Principles, Affiliated East West Press. Water Supply Engineering, B.C. Punmia, Laxmi Publications
2. R.W.Cahn and Peter Haasen, Physical Metallurgy.
3. Avner S.H., Introduction to Physical Metallurgy, Tata McGraw Hill.

4. Porter D.A. & Easterling K.E., Phase Transformations in Metals and Alloys.
5. Kakani S.L. and Kakani A., Materials Science, New Age International.
6. Clarke & Varney, Introduction to Physical Metallurgy.

Course Outcomes: Upon completion of this class, students are expected to

1. Analyse the Structure of materials at different levels, basic concepts of crystalline materials like unit cell, FCC, BCC, HCP, APF (Atomic Packing Factor), Co-ordination Number etc.
2. Understand concept of mechanical behaviour of materials and calculations of same using appropriate equations and Compare among different of crystal imperfections
3. Explain the concept of phase & phase diagram & understand the basic terminologies associated with solidification and casting and identification of phase diagrams and reactions
4. Understand and suggest the heat treatment process & types. Significance of properties Vs microstructure. Surface hardening & its types. Introduce the concept of hardenability & demonstrate the test used to find hardenability of steels

MMC102	Advanced Metallurgical Thermodynamics and Kinetics	3-0-0	Credits 3

Objectives of the course: To develop an understanding principles and concepts of thermodynamics of metallurgy and materials and to learn about equations and their applications in process metallurgy.

MODULE-I **(14 Hours)**

General principles: first and second law, mathematical formalism for the thermodynamic description of closed systems with constant composition. Mathematical formalism for the thermodynamic description of systems with variable composition. The chemical potential. Partial properties. -- Relation between integral and partial molar properties. Chemical potential of ideal gases (pure and mixtures) and non-ideal gases (pure and mixtures).

MODULE-II **(14 Hours)**

Chemical potential of pure liquids and solids and of components in liquid and solid solutions. The activity concept.Standard states and activities. Ideal solutions and non-ideal solutions. Activity coefficients.

Properties of solutions. Simple solution models. Introductory concepts of statistical thermodynamics. The regular solution model. Phase stability and phase diagrams. Reaction equilibrium, oxidation and reduction, Ellingham diagrams Thermodynamics vs. kinetics, homogeneous and heterogeneous reactions; Chemical Reaction Control-rate equation, reaction rate constant, reaction order, non-elementary reactions;

MODULE-III **(14 Hours)**

Solid State Diffusion -Fick's Law, mechanism of diffusion, uphill diffusion, Kirkendall effect, steady and transient diffusion;External Mass Transfer -fluid flow and its relevance to mass transfer, general mass transport equation, concept of mass transfer coefficient, models of mass transfer -film theory and Higbie's

penetration theory; Internal Mass Transfer-Ordinary and Knudsen diffusion, Mass transfer with reaction; Adsorption –physical adsorption vs. chemisorption, adsorption isotherms; Langmuir, BET, adsorption as the rate limiting step; gasification of C by CO2, dissolution of N2 in molten steel, porous solids, specific surface area and pore size distribution; Applications in extractive metallurgy, e.g. iron and steel making, copper making Applications in physical metallurgy, e.g. solid phase transformations and equilibria in metallic alloys, cemented carbides etc

Text/Reference Books:

1. Metallurgical Thermodynamics, Gaskell.
2. Ragone, David V., Thermodynamics of Materials. Vol. 1. New York, NY: Wiley.
3. Porter, David A., and K. E. Easterling, Phase Transformations in Metals and Alloys. 2nd ed. New York, NY: Chapman & Hall.
4. Balluffi, Robert W., Samuel M. Allen, and W. Craig Carter, Kinetics of Materials. Hoboken, NJ: J. Wiley & Sons.

Course Outcomes: Upon completion of this class, students are expected to

1. Understand concept of metallurgical thermodynamics of materials and calculations of same using appropriate equations and Compare among different of solutions
2. Explain the concept of phase equilibria & phase diagram & and identification of phase diagrams and reactions using Ellingham diagram.
3. Understand the diffusion process & types. Significance of physical adsorption Vs chemical adsorption. To determine the rate limiting steps of the reaction.
4. Applications in extractive metallurgy, e.g. iron and steel making, copper making

MME101	Solid State Phase Transformation	3-0-0	Credits 3

Objectives of the course: To develop the knowledge of the phase changes during both thermal and thermo mechanical treatments.

MODULE-I **(14 Hours)**

Introduction: Thermodynamics of phase equilibrium and phase changes; Definition, utility, order and classification of phase transformations. Diffusion: Definition of Fick's law on steady and non-steady state diffusion and their solutions; Mechanism of diffusion in solids; Chemical diffusion and Darken's equation; Kirkendall effect; Effect of pressure and temperature on diffusivity. Nucleation and growth: Formation of nucleus; Homogeneous and Heterogeneous nucleation; Mechanism and kinetics of thermally activated growth; Interface and diffusion control growth regimes. Phase equilibrium and phase diagrams: Important phase changes in unary and binary systems; Types and interpretation of phase diagram; Utility of phase diagrams, Lever rule; important phase diagrams in metallic and ceramic systems; Free energy Composition diagrams; Ternary phase diagrams; Isomorphous and eutectic Systems.

MODULE-II **(14 Hours)**

Solid state diffusive transformation: Classification of solid-solid transformations; Nucleation in solids; Precipitate growth; Age hardening; Spinodal decomposition; Precipitate coarsening. Order-disorder change, polymorphic change. Recrystallization, grain growth. Eutectoid transformation. Application of solid state precipitation. Pearlitic and bainitic transformations in steel; Zone refining, crystal growth, crystallography, stabilization. Annihilation of point imperfections, eutectoidal reaction, cellular reaction. Strengthening mechanisms, massive decomposition. Martensite and martensitic changes in ferrous materials.

MODULE-III **(14 Hours)**

Review of Iron-carbon alloy system: Iron-cementite and iron-graphite phase diagrams, cooling of hypo-eutectoid, eutectoid and hyper-eutectoid steels, hypo-eutectic, eutectic and hyper-eutectic cast irons, nucleation and growth of pearlite. Heat treatment of steels: TTT and CCT diagrams, conventional heat treatment processes – annealing, normalizing, hardening and tempering. Hardenability, role of alloying elements in steels. Surface hardening and chemical treatment in steels. Thermo-mechanical treatment of steels; High temperature and low temperature Thermo- Mechanical treatment. Heat treatment of some Cu, Al and Ti based alloys.

Text/Reference Books:

1. Porter D. A. and Easterling K. E., Phase Transformations in Metals and Alloys, CRC Press.
2. Sharma R. C., Phase Transformations in Materials.
3. Raghavan, Solid State Phase Transformations, PHI.
4. Thelning K E, Steel and its Heat treatment, Butterworth.
5. Rajan and Sharma, Heat Treatment, PHI.
6. Principles of Heat Treatment of Steels, ASM
7. Reed-Hill R. E., Physical Metallurgy Principles, East West Press.
8. Christian J.W., Theory of Transformations in Metals and Alloys, Pergamon Press.

Course Outcomes: Upon completion of this class, students are expected to

1. Understand concept of solidification using nucleation and growth and mathematical analysis of solute distribution using appropriate equations and Compare among different mechanisms of shrinkage during solidification.
2. Explain the concept of microstructure & various crystal growth of metals and alloys and identification of segregation and inclusions in casting.
3. Understand the melting practice of steel, Cu, Al and Ti based alloys & types. Significance of degassing and inoculation.
4. Applications of modeling of solidification in different alloy system etc.

MME102	Solidification of Metals and Alloys	3-0-0	Credits 3

Objectives of the course: To develop the knowledge of solidification and associated procedure of various engineering metals and alloys and apply them to study how it influences the microstructure of different metals and alloys.

MODULE-I **(14 Hours)**

Thermodynamics of solidification; Nucleation and growth; Pure metal solidification: Gibbs- Thomson effect; Alloy Solidification: Mathematical Analysis of redistribution of solute during solidification. Constitutional undercooling, Mullins-Sekerka instability, Heat flow and heat evolution, shrinkage during cooling and solidification

MODULE-II **(14 Hours)**

Solidification microstructure: Solidification of single phase alloys, directional solidification, crystal growth etc. Cells, dendrites, solidification of polyphase alloys, eutectic and peritectic solidification, growth of graphite in cast iron, segregation in castings, inclusions in castings etc.

MODULE-III **(14 Hours)**

Melting practice

Melting practice and special precautions for steels, alloy steels, cast irons, aluminium alloys, copper alloys and magnesium alloys, safety considerations, fluxing, degassing and inoculation. Modelling of solidification; Case studie.

Text/Reference Books:

1. Casting by J. Campbell, Butterworth - Haneman, London.
2. Solidification Processing by M.C. Flemings, McGraw Hill.
3. Principles of Metal Casting by Hein R.W., Loper C. R. & Rosenthal P.C, T.M.H.
4. Foundry Engineering by Taylor H.F., Flemming M.C. & Wulff, Wiley Eastern.
5. Foundry Technology by Beeley P.R., Butterworth, London.

Course Outcomes: Upon completion of this class, students are expected to

1. Understand concept of solidification using nucleation and growth and mathematical analysis of solute distribution using appropriate equations and Compare among different mechanisms of shrinkage during solidification.
2. Explain the concept of microstructure & various crystal growth of metals and alloys and identification of segregation and inclusions in casting.
3. Understand the melting practice of steel, Cu, Al and Ti based alloys & types. Significance of degassing and inoculation.
4. Applications of modeling of solidification in different alloy system etc.

MME103	Transport Phenomena in Metallurgy	3-0-0	Credits 3

Objectives of the course: To understand basic concepts related to momentum, heat, and mass transfer in the different metallurgical processes and mathematical derivation and equations related to above transport phenomena to comprehend the science behind process modeling.

MODULE-I **(14 Hours)**

Momentum transfer fundamentals: properties of fluids, types of fluid flow, viscosity of liquid and gases, laminar flow, momentum balance general momentum equation(GME) and its application in flow of falling film, flow through a circular tube, flow between the parallel plates, application of Navier Stokes Equations, turbulent flow: friction factors, flow past submerged bodies, flow through packed bed of solids, fluidized beds, energy balanced application in fluid flow: conservation of energy, flow through valves and fitting, flow from ladles.

MODULE-II **(14 Hours)**

Energy transport fundamentals: fouriers laws and thermal conductivity of liquids gases, solids and bulk materials, heat transfer and general energy equation and its application in heat transfer with convention and conduction in solids, examples of solidification in sand molds and metal molds, continuous casting, radiation heat transfer, black and grey body radiation, radiations from gases, its application to furnace enclosures and thermal behavior of metallurgical packed bed reactors.

MODULE-III **(14 Hours)**

Mass transfer fundamentals: molar density of mixture, mole fraction, molar flux, total molar fluxes, diffusion mechanisms in solids, Fick's first law and second law of diffusion, diffusion coefficient and inter diffusion coefficient, mass fraction, mass average velocity, general mass transport equation(GMT), application of (GMT): mass transfer through a near stagnant medium, mass transfer through a near stagnant medium with chemical reaction, examples such vaporization of Zn in molten copper , Silicon growth by chemical vapour deposition, loss of liquid Mn by passes of argon gases. Convective mass transfer: forced convection and natural convection, Navier Stokes Equations, application in mass transfer in laminar film flow, mass transfer in porous solids.

Text/Reference Books:

1. Geiger G.H. and Poirier D.R., Transport phenomena in metallurgy, addison-wesley publishingcompany.
2. Bird R.B.., Stewart W.E.and Lightfoot E.N., Transport phenomena. addison-wesley publishing company.

Course Outcomes:

1. Understand the basic fundamentals of momentum, heat and mass transfer phenomena in process

metallurgy. Determination of associated terms and derive related equations of transport process in metallurgy.

2. Understand and identification of different transport phenomena for different industrial problems and solutions
3. Understand how transport concepts and equations are used in the Modelling of metallurgical processes

MME104	Advanced Ferrous Production Technology	3-0-0	Credits 3

Objectives of the course: To develop the knowledge of modern trends in blast furnace principles and practice.

MODULE-I **(14 Hours)**

Blast furnace profile, Modern trends in Blast furnace

Sponge Iron making: Coal based processes: Rotary kiln process, Rotary hearth furnace process (Fastmet process, ITmk3 process). Gas based processes –Finmet process, Midrex process, HYL processes (HYL -III & HYL –IVM processes).

Smelting Reduction (SR): Fundamental of SR, Classification and important SR processes: COREX process, Finex process, Hismelt process, Romelt process.

MODULE-II **(14 Hours)**

Principles and practice of Duplex process for stainless steel making in AOD and VOD,

Ladle Metallurgy: Construction and Operation of LRF, Use of complex deoxidizers, deoxidation practices, Non-Metallic inclusions, Inclusion Engineering, gases in steel and degassing technology

MODULE-III **(14 Hours)**

Hybrid Steel making processes, Continuous steel making processes: WOCRA, IRSID, Spray steel making. environmental pollution in iron and steel industries

Text/Reference Books:

1. Biswas A.K., Principles of Blast Furnace Iron Making, SBA.
2. Ghosh Ahindra, Chatterjee A., Iron making and Steelmaking Theory and Practices, PHI Pvt. Ltd.
3. Tupkary R.H., Introduction to Modern Iron Making, Khanna Publishers
4. Gupta S.S. and Chatterjee A., Blast Furnace Iron Making, SBA New Delhi.
5. Tupkary R.H., An Introduction to Modern Steel Making, Khanna Publishers.
6. G.R. Bashforth, The Manufacture of Iron and Steel, Chapman & Hall.
7. Edneral F.P., Electrometallurgy of Steel and Ferroalloys, Vol. 1&2, Mir

Course Outcomes: Upon completion of this class, students are expected to

1. Understand concept of modern trends in blast furnace principles and practice and Compare among different types of process.
2. Explain the concept of duplex process of stainless steel making & uses of various deoxidizers and identification of gases and inclusions in steel.
3. Understand the hybrid steel making process & types. Significance of WOCRA and IRSID.
4. Applications and control of environmental pollution in iron and steel industries.

MME105	Diffusion in Materials	3-0-0	Credits 3

Objectives of the course: To develop the knowledge of basics of diffusion and related covering thermodynamics, defects, microstructure and growth kinetics of the phases in an inhomogeneous material system.

MODULE-I **(14 Hours)**

Diffusion Equations: Flux Equation, Diffusion Equation, Diffusion Equation (Constant D, Kinetics of Precipitation, Stress-Assisted Diffusion, Solution for Variable D, Two phase Binary Systems. Atomic Theory of Diffusion: Random Movement and the Diffusion Coefficient, Mechanism of Diffusion, Random Walk Problem, Calculation of D, Calculation of H and S from First Principles, Experimental Determination of Hv, Hm and Sv , Effect of Hydrostatic Pressure on Diffusion, Empirical Rules for Obtaining Q and D0, Divacancy Formation, Self Diffusion Anomalies.

MODULE-II **(14 Hours)**

Diffusion in Dilute Alloys: Interstitials and Anelasticity, Impurity Diffusion in Pure Metals, Correlation Effects, Interstitial Diffusion in Substitutional Alloys. Diffusion in a Concentration Gradient: The Kirkendal Effect, Darken Analysis, Phenomenological Equations, Relationship between Chemical D1 and Tracer D*1 , Test for Darken's Assumptions, Ternary Alloys.

MODULE-III **(14 Hours)**

Diffusion in non-Metals: Defects in Ionic Solids, Diffusion and Ionic Conduction, Experimental Check of Relation between σ and DT, Effect of Impurities on DT and σ, Effect of Impurities on Conductivity (Frenknel Disorder). High Diffusivity Paths: Analysis of Grain Boundary Diffusion, Experimental Observations on Grain Boundary Diffusion, Dislocation & Grain Size Effects, Diffusion along Moving Boundaries, Surface Diffusion and Shape Change

Text/Reference Books:

1. Shewmon, P., Diffusion in Solids, 2nd Edition, Wiley, 1991
2. A.Paul, T. Laurila, V. Vuorinen, S. Divinsky, Thermodynamics, Diffusion and the Kirkendall effect in Solids, Springer, 2014.

Course Outcomes: Upon completion of this class, students are expected to

1. Understand concept of Diffusion-controlled phase transformation and microstructural evolution in inhomogeneous material systems. Compare among different types of diffusion process.**calculations** of same using appropriate equations.
2. Explain the concept of defects in materials system and ***identification*** of defects and inclusions in materials system.
3. Applications and control of diffusion in metallic and nonmetallic systems.

MME106	Engineering Composites	3-0-0	Credits 3

Objectives of the course: To develop the knowledge of different types of composite materials along with their properties and processing for various engineering applications.

MODULE-I **(14 Hours)**

Introduction: Definition, classification, properties, applications, advantages and limitations of composites, Types of matrix and reinforcements, and their properties. Mechanics of Composites, Iso strain and Iso stress conditions, Role of fibers, Critical fiber length.

MODULE-II **(14 Hours)**

Fabrication of Polymer Matrix Composites (PMCs): Properties, Applications and Limitations of PMCs; Various fabrications methods- Filament winding; Resin injection moulding; extrusion, calendering, pultrusion, degradation of fibers. Sandwich structures, foam core type arrangements; Honey comb structures. Hand Layup technique, Spray Up Technique, Filament welding, Pultrusion, Autoclave based methods, Injection moulding, Extrusion.

Fabrication of Metal Matrix Composites (MMCs): Properties, Applications of MMCs; Fabrications methods: Liquid methods- Duralcan process, Spray forming, Squeeze casting, Stir casting; Solid state process- Diffusion bonding.

MODULE-III **(14 Hours)**

Fabrication of Ceramic Matrix Composites (CMCs): Properties, Applications and limitations of CMCs; Various fabrications methods: Cold pressing and sintering, Hot pressing, Liquid infiltration, Lanxide process. Fabrication of Carbon-Carbon Composites (CCCs): Properties, Applications and limitations of CCCs; Processing of CCC- Solid, Liquid and Gas phase pyrolysis processes.

Text/Reference Books:

1. Materials Science and Engineering: An Introduction - William D Callister Jr
2. Composite materials, K.K. Chawala; 2nd ed., Springer-Verlag, 1987.
3. Nanocomposite Science and Technology, P. M. Ajayan, L. S. Schadler, P. V. Braun; Wiley-VCH

Verlag GmbH Co, 2013.

4. Mechanics and Analysis of Composite Materials, V.V. Vasiliev, E.V. Morozov; Elsevier Science Ltd, 2001.
5. Ceramic matrix composites, K.K. Chawala; 1st ed., Chapman & Hall, 1993.
6. Advances in composite materials, G. Piatti Applied Science Publishers Ltd., 1978.
7. Composite Materials, Mel. M. Schwartz; Vol 1 & 2, Prentice - Hall PTR, 1997.
8. Advanced Polymer composites, BorZ.Jang; ASM International,1994

Course Outcomes: At the end of the course, the student should be able to

1. Understand the different fabrication of composites and calculate their properties with appropriate equations and compare among them for different applications.
2. Understand the benefits and disadvantages of composites in different application.
3. Analyse the mechanics and failures of various composites with the help of different tools.
4. Explain and select new class of materials for extreme environment application.

MMC103	Physical Metallurgy and Metallography Lab	0-0-4	Credits 2

Objectives of the course: To demonstrate the physical properties and microstructure of different metals and alloys qualitatively as well as quantitatively.

List of suggested experiments:

1. Annealing treatment of a cold worked steel and comparison of the annealed microstructure with the cold worked structure.
2. Normalizing treatment of steel and comparison of the microstructure with annealed structure.
3. To study the quenched structures of steel – quenched in oil, water and brine solution.
4. To study the quenched and tempered structures of steel –
   (i) low temperature tempering.
   (ii) medium temperature tempering.
   (iii) high temperature tempering.
5. To study the recrystallization behaviour of pure metal (iron / copper).
6. To study the effect of time and temperature on grain size of a metal (grain growth) (iron/ copper).
7. To study the nucleation rate and growth rate of pearlite in eutectoid steel.
8. To study the susceptibility of a steel to harden by quenching (hardenability) by Jominy test.
9. Pack carburizing of 0.2% carbon steel and to measure the diffusion coefficient of carbon in steel.

10. To study the microstructure of tool steels, stainless steels and other high alloy steels.
11. Austempering of steels and S G cast irons.
12. To carry out age hardening of non-ferrous alloys.
13. Determination of hardenability of steels.

Course Outcomes: Upon completion of this class, students are expected to

1. Demonstrate the physical properties and microstructure of metals and alloys as qualitatively and quantitatively using different tools.
2. Selection and identification of metals and alloys for different industrial applications.

MMC104	Metallurgical Thermodynamics Lab	0-0-4	Credits 2

Objectives of the course: To demonstrate the kinetics of different metallurgical processes qualitatively as well as quantitatively.

List of suggested experiments:

1. Determination of the standard free-energy change in the form a + bT for the reaction: CaCO3 (s) = CaO (s) + CO2 (g).
2. Determination of the standard free-energy change in the form a + bT for the reaction: CO2 (g) + C (s) = 2CO (g).
3. Preparation of DRI by the hydrogen reduction of Fe2O3 pellets in a TGA and its kinetic study.
4. Determination of the activity-composition relationship for Zn in the system Zn-Cu by the measurement of vapor pressure.
5. Evaporation of liquid lead in stagnant argon and the determination of the lead vapor-argon inter diffusivity.
6. Hydro- and electrometallurgical recovery of Zn from ZnS. 7. Determination of enthalpy change using a DTA.
7. Extraction of copper by carbothermic reduction of cupric oxide.
8. Oxidation kinetics of copper sulfide.
9. Kinetic studies of oxidation of copper.
10. Kinetic studies of reduction of iron ores.
11. Kinetic studies of decomposition of calcium carbonate.
12. Kinetic studies of decomposition of magnesium carbonate.
13. To study the flow of gases through beds of solid particles.

14. Determination of heat transfer coefficient by using Newton's Law of cooling.
15. Leaching of sulphide ores.

Course Outcomes: Upon completion of this class, students are expected to

1. Demonstrate the thermodynamics and kinetics of metallurgical processes as qualitatively and quantitatively using different tools.
2. Selection and identification of materials and processes for different industrial applications.

GHM101	Research Methodology & Intellectual Property Rights	2-0-0	Credits 2

MODULE-I **(06 Hours)**

Meaning of research problem, Sources of research problem, Criteria characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.

Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

MODULE-II **(04 Hours)**

Effective literature studies approaches, analysis,

Plagiarism, Research ethics.

MODULE-III **(04 Hours)**

Effective technical writing, how to write report, Paper.

Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

MODULE-IV **(06 Hours)**

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

MODULE-V **(04 Hours)**

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

MODULE-VI **(04 Hours)**

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Text/Reference Books:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science& engineering students'".
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.
5. Mayall, "Industrial Design", McGraw Hill, 1992.
6. Niebel, "Product Design", McGraw Hill, 1974.
7. Asimov, "Introduction to Design", Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016.
9. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

Course Outcomes: At the end of the course, students will be able to

1. Understand research problem formulation.
2. Analyze research related information
3. Follow research ethics
4. Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property.

   Right to be promoted among students in general & engineering in particular.
6. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Audit Courses

AHM101	English for Research Paper Writing	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Understand that how to improve your writing skills and level of readability
2. Learn about what to write in each section
3. Understand the skills needed when writing a Title

   Ensure the good quality of paper at very first-time submission

MODULE-I **(4 Hours)**

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

MODULE-II **(4 Hours)**

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction.

MODULE-III **(4 Hours)**

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

MODULE-IV **(4 Hours)**

key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed whenwriting a Review of the Literature.

MODULE-V **(4 Hours)**

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions.

MODULE-VI **(4 Hours)**

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

Suggested Studies:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book.

4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

ACE101	Disaster Management	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

MODULE-I **(4 Hours)**

Introduction

Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

MODULE-II **(4 Hours)**

Repercussions of Disasters and Hazards:

Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem.

Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

MODULE-III **(4 Hours)**

Disaster Prone Areas In India

Study of Seismic Zones; Areas Prone To Floods And Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics

MODULE-IV **(4 Hours)**

Disaster Preparedness and Management

Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data From Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness.

MODULE-V **(4 Hours)**

Risk Assessment

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategiesfor Survival.

MODULE-VI **(4 Hours)**

Disaster Mitigation

Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation In India.

Text / Reference Books:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies, NewRoyal book Company.
2. Sahni, Pardeep Et.Al. (Eds.)," Disaster Mitigation Experiences and Reflections", Prentice Hall of India, New Delhi.
3. Goel S. L., Disaster Administration and Management Text and Case Studies" ,Deep &Deep Publication Pvt. Ltd., New Delhi.

AHM102	Sanskrit for Technical Knowledge	2-0-0	Credits 0

Course Objectives:

1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. Learning of Sanskrit to improve brain functioning
3. Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power
4. The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature

MODULE-I **(8 Hours)**

- Alphabets in Sanskrit
- Past/Present/Future Tense
- Simple Sentences

MODULE-II **(8 Hours)**

- Order
- Introduction of roots
- Technical information about Sanskrit Literature

MODULE-III **(8 Hours)**

- Technical concepts of Engineering-Electrical, Mechanical,Architecture, Mathematics

Suggested reading:

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

Course Output: Students will be able to

1. Understanding basic Sanskrit language
2. Ancient Sanskrit literature about science & technology can be understood
3. Being a logical language will help to develop logic in students

AHM103	Value Education	2-0-0	Credits 0

Course Objectives: Students will be able to

1. Understand value of education and self- development
2. Imbibe good values in students
3. Know about the importance of character

MODULE-I **(6 Hours)**

- Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism.
- Moral and non- moral valuation. Standards and principles.
- Value judgements

MODULE-II **(6 Hours)**

- Importance of cultivation of values.
- Sense of duty.Devotion, Self-reliance.Confidence, Concentration. Truthfulness, Cleanliness.
- Honesty, Humanity.Power of faith, National Unity.
- Patriotism.Love for nature, Discipline

MODULE-III **(6 Hours)**

- Personality and Behavior Development - Soul and Scientific attitude.
- Positive Thinking. Integrity and discipline.
- Punctuality, Love and Kindness.
- Avoid fault Thinking.
- Free from anger, Dignity of labour.
- Universal brotherhood and religious tolerance.
- True friendship.
- Happiness Vs suffering, love for truth.
- Aware of self-destructive habits.
- Association and Cooperation.
- Doing best for saving nature

MODULE-IV **(6 Hours)**

- Character and Competence –Holy books vs Blind faith.
- Self-management and Good health.
- Science of reincarnation.
- Equality, Nonviolence, Humility, Role of Women.
- All religions and same message.
- Mind your Mind, Self-control.
- Honesty, Studying effectively

Text / Reference Books

1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

Course outcomes: Students will be able to

1. Knowledge of self-development

2. Learn the importance of Human values
3. Developing the overall personality

AHM104	Constitution of India	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutionalrole and entitlement to civil and economic rights as well as the emergence of nationhood inthe early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the BolshevikRevolution in 1917 and its impact on the initial drafting of the Indian Constitution.

MODULE-I **(4 Hours)**

- **History of Making of the Indian Constitution:**

  History

  Drafting Committee, (Composition& Working)

MODULE-II **(4 Hours)**

- **Philosophy of the Indian Constitution:**

  Preamble

  Salient Features

MODULE-III **(4 Hours)**

- **Contours of Constitutional Rights & Duties:**

  Fundamental Rights

  Right to Equality

  Right to Freedom

  Right against Exploitation

  Right to Freedom of Religion

  Cultural and Educational Rights

  Right to Constitutional Remedies

  Directive Principles of State Policy

Fundamental Duties.

MODULE-IV **(4 Hours)**

- **Organs of Governance:**

  Parliament

  Composition

  Qualifications and Disqualifications

  Powers and Functions

  Executive

  President

  Governor

  Council of Ministers

  Judiciary, Appointment and Transfer of Judges, Qualifications

  Powers and Functions

MODULE-V **(4 Hours)**

- **Local Administration:**

  District's Administration head: Role and Importance,

  Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation.

  Pachayati raj: Introduction, PRI: ZilaPachayat.

  Elected officials and their roles, CEO ZilaPachayat: Position and role.

  Block level: Organizational Hierarchy (Different departments),

  Village level: Role of Elected and Appointed officials,

  Importance of grass root democracy

  Model Curriculum of Engineering & Technology PG Courses [Volume -II]

MODULE-VI **(4 Hours)**

- **Election Commission:**

  Election Commission: Role and Functioning.

  Chief Election Commissioner and Election Commissioners.

  State Election Commission: Role and Functioning.

  Institute and Bodies for the welfare of SC/ST/OBC and women.

Text / Reference Books:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Outcomes: Students will be able to:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the passage of the Hindu Code Bill of 1956.

AHM105	Pedagogy Studies	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Review existing evidence on the review topic to inform programme design and policymaking undertaken by the DfID, other agencies and researchers.
2. Identify critical evidence gaps to guide the development.

MODULE-I **(4 Hours)**

- **Introduction and Methodology:**
- Aims and rationale, Policy background, Conceptual framework and terminology
- Theories of learning, Curriculum, Teacher education.
- Conceptual framework, Research questions**.**
- Overview of methodology and Searching.

MODULE-II **(2 Hours)**

- Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries.
- Curriculum, Teacher education.

MODULE-III **(4 Hours)**

- Evidence on the effectiveness of pedagogical practices
- Methodology for the in depth stage: quality assessment of included studies.
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?
- Theory of change.
- Strength and nature of the body of evidence for effective pedagogical practices.
- Pedagogic theory and pedagogical approaches.
- Teachers' attitudes and beliefs and Pedagogic strategies.

MODULE-IV **(4 Hours)**

- Professional development: alignment with classroom practices and follow up support
- Peer support
- Support from the head teacher and the community.
- Curriculum and assessment
- Barriers to learning: limited resources and large class sizes

MODULE-V **(2 Hours)**

- **Research gaps and future directions**
- Research design
- Contexts
- Pedagogy
- Teacher education
- Curriculum and assessment
- Dissemination and research impact.

Text / Reference Books:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2):245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal ofCurriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International JournalEducational

Development, 33 (3): 272–282.

5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

Course outcomes: Students will be able to understand:

1. What pedagogical practices are being used by teachers in formal and informal classrooms indeveloping countries?
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, andwith what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

AHM106	Stress Management by Yoga	2-0-0	Credits 0

Course Objectives:

1. To achieve overall health of body and mind
2. To overcome stress

MODULE-I **(8 Hours)**

- Definitions of Eight parts of yoga. (Ashtanga)

MODULE-II **(8 Hours)**

- Yam and Niyam.

  Do`s and Don't's in life.

  i) Ahinsa, satya, astheya, bramhacharya and aparigraha

  ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

MODULE-III **(8 Hours)**

- Asan and Pranayam

  i) Various yog poses and their benefits for mind & body

  ii) Regularization of breathing techniques and its effects-Types of pranayam

Text / Reference Books:

1. 'Yogic Asanas for Group Tarining-Part-I" :Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

Course outcomes: Students will be able to:

1. Develop healthy mind in a healthy body thus improving social health also
2. Improve efficiency

AHM107	Personality Development through Life Enlightenment Skills	2-0-0	Credits 0

Course Objectives:

1. To learn to achieve the highest goal happily
2. To become a person with stable mind, pleasing personality and determination
3. To awaken wisdom in students

MODULE-I **(8 Hours)**

Neetisatakam-Holistic development of personality

- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)
- Verses- 52,53,59 (dont's)
- Verses- 71,73,75,78 (do's)

MODULE-II **(8 Hours)**

Approach to day to day work and duties.

- Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48,
- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,
- Chapter 18-Verses 45, 46, 48.

MODULE-III **(8 Hours)**

Statements of basic knowledge.

- Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68
- Chapter 12 -Verses 13, 14, 15, 16,17, 18
- Personality of Role model. Shrimad Bhagwad Geeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
- Chapter 4-Verses 18, 38,39
- Chapter18 – Verses 37,38,63

Text / Reference Books:

1. "Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (PublicationDepartment), Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

Course outcomes: Students will be able to:

1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achievethe highest goal in life
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity
3. Study of Neetishatakam will help in developing versatile personality of students.

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

M.TECH SYLLABUS for *Specialization*: METALLURGICAL AND MATERIALS ENGINEERING

BRANCH: METALLURGICAL AND MATERIALS ENGINEERING (2018-19 Admission Batch)

2nd semester

MMC201	Mechanical Behaviour of Materials	3-0-0	Credits 3

Objectives of the course: To develop the knowledge about the essential elastic-plastic behavior and properties of engineering materials such as fracture and creep and to apply them to design the materials for various load-bearing structural engineering applications.

MODULE-I **(14 Hours)**

Introduction: Elastic, plastic and visco-elastic deformation.

Continuum mechanics: Concepts of stress and strain in 3D stress and strain tensor, principal stresses and strains and principal axes, mean stress, stress deviator, maximum shear, equilibrium of stresses, equations of compatibility.

Elastic behaviour of materials: Constitutive equations in elasticity for isotropic and anisotropic materials, strain energy, elastic stiffness and compliance tensor, effect of crystal structure on elastic constants.

Plastic response of materials-a continuum approach: classification of stress-strain curves, yield criteria.

MODULE-II **(14 Hours)**

Dislocation Theory: Elements of dislocation theory, movement of dislocation, elastic properties of dislocation, intersection of dislocation, dislocation reactions in different crystal structures, origin and multiplication of dislocations.

Plastic deformation of single crystals: Critical resolved shear stress, deformation by twinning, deformation band and kink band, strain hardening of single crystal; stress-strain curves of fcc, bcc and hcp materials.

MODULE-III **(14 Hours)**

Plastic deformation of polycrystalline materials: Role of grain boundaries in deformation, strengthening by grain boundaries, yield point phenomenon, strain ageing, strengthening by solutes, precipitates, dispersoids and fibres.

Tension test- Engineering & true stress-strain curves, evaluation of tensile properties, Tensile instability, Effect of strain-rate & temperature on flow properties.

Creep- Creep & Stress rupture tests, Mechanism of creep deformation, Deformation mechanism Maps,

Development of creep resistant alloys, Prediction of long time properties.

Deformation in non-metallic materials: structure and deformation of polymers, concept Super-lattice dislocations in intermetallics, concept of charge associated with dislocations in ceramics.

Text/Reference Books:

1. Mechanical Metallurgy by G. E. Dieter, McGraw-Hill.
2. Deformation and Fracture Mechanics of Engineering Materials by R.W. Hertzberg, John Wiley.
3. Mechanical Behaviour of Materials by M. A. Meyers and K. K. Chawla
4. Mechanical Behaviour of Materials by T.H. Courtney

Course Outcomes: Upon completion of this class, students are expected to

1. Understand concept of elasticity and plasticity of materials and calculations of same using appropriate equations.
2. Explain the concept of dislocation & deformation behaviour of single crystal and polycrystalline materials & and identification of dislocation and reactions.
3. Understand the deformation process & types. Significance of deformation mechanisms maps. To determine the different properties of the materials.
4. Applications in deformation of non-metallic materials, e.g. polymer, intermetallic and ceramics etc

MMC202	Characterization of Materials	3-0-0	Credits 3

Objectives of the course: To provide an understanding of the basic principles of various characterization tools and use those tools to analyze metallurgical components

MODULE-I **(14 Hours)**

Introduction: Scope of subject, classification of techniques for characterization, macro and micro-characterization structure of solids. Bulk averaging techniques:

Diffraction methods: X-ray diffraction, indexing XRD pattern, X-ray topography, residual stress measurement techniques, small angle X-ray and neutron scattering.

MODULE-II **(14 Hours)**

Electron optical methods: Scanning electron microscopy and X-ray microanalysis including electron probe microanalysis, electron optics, electron beam specimen interaction, image formation in the SEM. X-ray spectral measurements: WDS and EDS, quantitative X-ray analysis; application of SEM and EPMA to solid samples and biological materials; type of data base required to process the results.

Analytical transmission electron microscopy: principles, Electron diffraction, reciprocal lattice, analysis of SAD patterns; different electron diffraction techniques, atomic resolution microscopy, analytical devices with

TEM, field ion microscopy, scanning tunneling microscopy, advanced techniques.

MODULE-III **(14 Hours)**

Thermal analysis: DTA, DSC, TGA, dilatometry, resistivity/ conductivity.

Optical & X-ray spectroscopy: Atomic absorption spectroscopy, X-ray spectrometry, infrared spectroscopy and Raman spectroscopy.

Mass spectroscopy: Principles and brief account.

Methods based on sputtering or scattering phenomena: Field ion microscopy, atom probe microanalysis, low energy ion scattering spectroscopy, Rutherford back scattering spectroscopy, ion channeling and secondary ion mass spectroscopy.

Chromatography: Principles of gas chromatography, mass spectrometry, liquid and ion chromatography.

Text/Reference Books:

1. Materials Characterization, Metals Handbook, Vol 10, ASM
2. Characterization of Materials, by E N Kaufman, Wiley Publishers
3. Structure of Metals, by Barett, C.S. and Massalski, T.B., Pergamon Press, Oxford.
4. Elements of X-ray Diffraction, by Cullity B.D., Addison-Wesley, 1978
5. Transmission Electron Microscopy by Williams, D.B. and Barry Carter C., Plenum Press.
6. Scanning Electron Microscopy and X-Ray Microanalysis, by J.I. Goldstein, C. E. Lyman
7. Differential Thermal Analysis by R.C.Machenzie
8. Modern Metallographic Techniques and their application by Victor A.Phillips

Course Outcomes: Upon completion of this class, students are expected to

1. Understand concept of the principles of X-ray Diffractrometer (XRD), Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM), Thermal analysis and dilatometer.
2. Explain the sample preparation techniques for XRD, SEM. AND TEM & Determination of various crystal structures, lattice parameters, compositions and morphology. Identification of different phases and stress analysis of materials.
3. Analyse the material in atomic level by using different modes of TEM like bright and dark field imaging, selected area diffraction
4. Understand the principles of spectroscope & types. Significance of microanalysis.
5. Applications and Selection of the appropriate tool to characterize the material by knowing its merits and demerits.

MME201	Biomaterials	3-0-0	Credits 3

Objectives of the course: To understand the basic principles and language associated with current biomaterials research and to understand the issues associated with medical applications of these materials

MODULE-I **(14 Hours)**

Introduction: Definition of Biomaterials: Performance of Biomaterials; Brief Historical Background.

Metallic Implant Materials: Stainless Steels; Co-Based Alloys; Ti and Ti-Based Alloys; Dental Metals; Other Metals; Corrosion of Metallic Implants. Ceramic Implant Materials: Structure–Property Relationship of Ceramics; Aluminum Oxides (Alumina); Zirconium Oxides (Zirconia); Calcium Phosphate; Glass-Ceramics; Other Ceramics; Carbons; Deterioration of Ceramics.

MODULE-II **(14 Hours)**

Polymeric Implant Materials: Polymerization and Properties; Effect of Structural Modification and Temperature on Properties; Polymeric Implant Materials; High-Strength Thermoplastics; Deterioration of Polymers. Composites as Biomaterials: Structure; Mechanics of Composites; . Applications of Composite Biomaterials; Biocompatibility of Composite Biomaterials. Structure–Property Relationships of Biological Materials: Proteins; Polysaccharides; Structure–Property Relationship of Tissues. Tissue Response to Implants: Normal Wound-Healing Process; Body Response to Implants; Blood Compatibility; Carcinogenicity.

MODULE-III **(14 Hours)**

Soft Tissue Replacement: Sutures, Skin,and Maxillofacial Implants: Sutures, Surgical Tapes, and Adhesives; Percutaneous and Skin Implants; Maxillofacial and Other Soft-Tissue Augmentation.

Blood Interfacing Implants: Blood Substitutes and Access Catheters; Cardiovascular Grafts and Stents; Blood Vessel Implants; Heart Valve Implants; Heart and Lung Assist Devices; Artificial Organs.

Hard Tissue Replacement: Long Bone Repair: Wires, Pins, and Screws; Fracture Plates; Intramedullary Devices; Acceleration of Bone Healing. Joints and Teeth: Joint Replacements; Spinal Implants; Dental Restorations and Implants; Interface Problems in Orthopedic and Dental Implants.

Books for reference:

1. Biomaterials - An Introduction, Third Edition, by JoonPark and R.S.Lakes, Published by Springer.
2. Biomaterials Science: An Introduction to Materials in Medicine, edited by B.D.Ratner, A.S.Hoffman, F.J.Schoen, J.E.Lemons, Academic Press.

Course Outcomes: Upon completion of this class, students are expected to

1. Understand the fundamental principles and language associated with biomaterials and implants.
2. Understand the fundamentals principles of biomedical devices and operational principles of devices made of these biomaterials.
3. Design the biomaterials with their function, properties and biocompatibility.
4. Applications and Selection of the appropriate biomaterials by knowing its merits and demerits.

MME202	Nano Materials	3-0-0	Credits 3

Objectives of the course: To understand the basic principles and language associated with current biomaterials research and to understand the issues associated with medical applications of these materials.

MODULE-I **(14 Hours)**

Introduction: Types of nanomaterials, emergence of nanotechnology, bottom-up and top-down approaches, challenges in nanotechnology.

Nanoparticles: synthesis of metallic nanoparticles, semiconductor nanoparticles, oxide nanoparticles (sol-gel processing); vapour phase reactions, solid phase segregation.

Nanowires: Synthesis of nanowires by evaporation – condensation growth, VLS or SLS growth, stress induced recrystallization, template based synthesis, electrospinning, lithography.

Thin Films: fundamentals of film growth, PVD, CVD and ALD.

MODULE-II **(14 Hours)**

Special Nanomaterials: Carbon fullerenes and nanotubes, micro and mesoporous materials, core-shell structures, organic – inorganic hybrids, nanocomposites and nanograined materials.

Nanostructures fabricated by physical techniques: lithography - photolithography, electron beam lithography, X-ray lithography, FIB lithography; nanolithography - STM, AFM, NSOM; soft lithography; assembly of nanoparticles and nanowires and other methods of microfabrication.

MODULE-III **(14 Hours)**

Characterization and properties of nonmaterials: Structural characterization by XRD, SAXS, SEM, TEM, SPM, gas adsorption; Chemical characterization by spectroscopy techniques; Mechanical properties; Optical, electrical and magnetic properties.

Applications of nanomaterials: molecular electronics and nanoelectronics, nanobots, biological applications, catalytic applications, quantum devices, carbon nanotube emitters, nanofluids.

Books for reference:

1. Nanostructures and Nanomaterials: Synthesis, Properties and Applications by G. Cao, Imperial College Press.
2. Nanomaterails Handbook, (Ed.) by Y. Gagotsi, Taylor and Francis.
3. Introduction to Nanotechnology by C. P Poole and F. T. Owee, Willey Press.
4. Nano Materials Synthesis, Properties and Applications, by Edlstein and Cammarate.
5. Nano Materials, by A.K. Bandyopadyay, New age Publications.
6. Nano - The Essentials, by T. Pradeep, TMH.
7. Nanostructured Materials: Processing, Properties and applications, by C. Koch, William Andrew Publishing

Course Outcomes: Upon completion of this class, students are expected to

1. Understand the terminologies used in the field of nano materials
2. Classification of different methods of synthesis of nano materials
3. Selection nano materials for different industrial applications
4. Understand the health issues related to nano materials

MME203	Principles of Electronic Materials	3-0-0	Credits 3

Objectives of the course: To understand the basic principles and physical origins of electronic properties of materials and to study the various materials that exhibits these functional properties.

MODULE-I **(14 Hours)**

Introduction: Modem Theory of Solids: Hydrogen Molecule: Molecular Orbital Theory of Bonding, Band Theory of Solids, Energy Band Formation, Properties of Electrons in a Band , Semiconductors Electron Effective Mass, Density of States in an Energy Band , Statistics: Collections of Particles, Boltzmann Classical,Statistics, Fermi-Dirac Statistics, Quantum Theory of Metals Free Electron Model , Conduction in Metals, Fermi Energy Significance, Metal-Metal Contacts: Contact Potential, The Seebeck Effect and the Thermocouple, Thermionic Emission and Vacuum Tube Devices, Thermionic Emission: Richardson, Dushman Equation, Schottky Effect and Field Emission Phonons , Harmonic Oscillator and Lattice Waves, Debye Heat Capacity, Thermal Conductivity of Nonmetals Electrical Conductivity.

MODULE-II **(14 Hours)**

Semiconductors: Intrinsic Semiconductors, Silicon Crystal and Energy Band, Diagram, Electrons and Holes, Conduction in Semiconductors, Electron and Hole Concentrations, Extrinsic Semiconductors, n-Type Doping, p-Type Doping, Compensation Doping, Temperature Dependence of Conductivity, Carrier Concentration Temperature Dependence, Drift Mobility: Temperature and Impurity Dependence, Conductivity Temperature Dependence, Degenerate and Nondegenerate, Semiconductors, Recombination and Minority Carrier Injection, Direct and Indirect Recombination, Minority Carrier Lifetime, Diffusion and Conduction Equations, and Random Motion, Continuity Equation, Time-Dependent Continuity Equation, Steady-State Continuity, Optical Absorption,Piezoresistivity,Schottky Junction,Schottky Diode, Schottky Junction Solar Cell, Ohmic Contacts and Thermoelectric.

Coolers

MODULE-III **(14 Hours)**

Dielectric Materials and Insulation: Matter Polarization and Relative Permittivity, Relative Permittivity: Definition, Dipole Moment and Electronic Polarization, Polarization Vector P Local Field Eioc and Clausius-Mossotti Equation Electronic Polarization: Covalent Solids, Polarization Mechanisms, Ionic Polarization ,Orientation (Dipolar)Polarization, Interfacial Polarization, Total Polarization, Frequency Dependence: Dielectric Constant and Dielectric Loss ,Dielectric Loss , Debye Equations, Cole-Cole Plots, and Equivalent Series Circuit, Gauss's Law and Boundary Dielectric Strength and Insulation: Breakdown, Dielectric Strength: Definition, Dielectric Breakdown and Partial Discharges: Gases, Dielectric Breakdown: Liquids, Dielectric

Breakdown: Solids, Capacitor Dielectric Materials, typical Capacitor Constructions, Dielectrics: Comparison, Piezoelectricity, Ferro electricity, and Piezoelectricity, Piezoelectricity, Piezoelectricity: Quartz Oscillators and Filters, Ferroelectric and Pyroelectric Crystals, Electric Displacement and Depolarization Field ,Local Field and the Lorentz Equation, Dipolar Polarization, Ionic Polarization and Dielectric Resonance, Dielectric Mixtures and Heterogeneous Media.

Books for reference:

Texts:

1. Principles of Electronic Materials and Devices, by S.O.Kasap, McGraw-Hill publisher

Reference:

1. Electronic properties of materials by R.E.Hummel, Springer.
2. Electronic properties of engineering materials by J.D.Livingston, John Wiley.

Course Outcomes:Upon completion of this class, students are expected to

1. Understand concept the band gap theory for conducting, semiconducting and insulating materials and related electrical phenomenon such as ferro electricity, piezo electricity and pyro electricity along with dielectric behaviour of materials.
2. Understand the fundamentals of semiconducting materials and operational principles of solid state devices made of these semiconducting materials.
3. Determine the dc and ac mobility, electrical conductivity,. P-n junction, dielectric constant and dielectric loss etc.
4. Applications and Selection of the appropriate materials by knowing its merits and demerits.

MME204	Degradation of Materials	3-0-0	Credits 3

Objectives of the course: To understand the basic principles of corrosion and its applications in engineering field

MODULE-I **(14 Hours)**

Technological importance of corrosion study, corrosion as non-equilibrium process, corrosion rate expressions, electrochemical principles of corrosion-cell analogy, concept of single electrode potential, reference electrodes, e.m.f. and galvanic series-their uses in corrosion studies, polarization, passivity. Different forms of corrosion-uniform attack, galvanic, crevice, pitting, intergranular, selective leaching, erosion, stress corrosion cracking-their characteristic features, causes and remedial measures.

MODULE-II **(14 Hours)**

Principles of corrosion prevention-material selection, control of environment including inhibitors, cathodic and anodic protection, coatings and design considerations. Corrosion testing methods.

Introduction to high temperature corrosion, Pilling-Bedworth ratio, oxidation kinetics, oxide defect structures, Wagner-Hauffe valence approach in alloy oxidation, catastrophic oxidation, internal oxidation.

MODULE-III **(14 Hours)**

Considerations in high temperature alloy design, prevention of high temperature corrosion -use of coatings.

Liquid metal attack - liquid metal embrittlement, preventive measures.Chemical degradation of non-metallic materials like rubbers, plastics, ceramics etc. Hydrogen damage - types, characteristics, mechanism and preventive measures.

Text/Reference Books:

1. Corrosion Engineering by Fontana, M.G., McGraw-Hill.
2. Corrosion & Corrosion control by H.H. Uhlig, John Wiley & Sons.
3. Introduction to Metallic Corrosion by Evans.
4. Introduction to Electrochemistry by S.Glasstone.
5. An Introduction to Science of Corrosion & its Inhibition by S.N. Banerjee, Oxonian Press Pvt. Ltd.

Course Outcomes:Upon completion of this class, students are expected to

1. Understand the basic principles of corrosion and types
2. Determination of corrosion rate and associated terms related to polarization.
3. Selection and identification of corrosion of materials for different industrial problems and applications
4. Understand basic principles and the different issues related to high temperature corrosion of materials

MME205	Material Failure and Analysis	3-0-0	Credits 3

Objectives of the course: To understand basic concepts related to modes and cause of failures and their analysis in the different metallurgical processes and selection and identification of materials for prevention failure of materials.

MODULE-I **(14 Hours)**

Fracture Mechanics:

Stress intensity factor, stress analysis of cracks, Derivation of the relationship between strain energy release rate and stress intensity factor. Crack- tip plastic zone, Dugdales's plastic strip model.

Plane stress versus plane strain, Crack opening displacement, Plain strain fracture toughness K_{IC} testing, fracture toughness determination with elastic plastic analysis (J_{IC}).

MODULE-II **(14 Hours)**

Fatigue:

(i) Stress Life Approach, S-N Curve, Factors affecting fatigue under this approach.

(ii) Strain Life Approach: Low cycle fatigue, Coffin-Manson equation, Strain Life equation. Nubers Approach.

(ii) Fatigue crack propagation: Paris law, Fatigue life estimation, Factors affecting fatigue crack growth rate.

MODULE-III **(14 Hours)**

Stress corrosion cracking, K_{iscc} determination, Corrosion fatigue, Temper embrittlement, Hydrogen embrittlement, SEM fractography of ductile (Dimple), brittle (cleavage), Fatigue fractured surface.

Failure Analysis:

Principles and procedures of Failure Analysis.

Text/Reference Books:

1. Mechanical Metallurgy byG. E. Dieter, McGraw-Hill Company.
2. Deformation and Fracture Mechanics of Engineering Materials byR.W. Hertzberg:, John Wiley.
3. Elementary Fracture Mechanics by D. Broek, Martinus Nijho Publisher.
4. Failure Analysis & Prevention (Vol. - X), Metal Hand Book, ASM Publication.
5. Mechanical Behaviour of Materials byM. A. Meyers and K. K. Chawla.
6. Mechanical Behaviour of Materials byT.H. Courtney.
7. Fatigue of Materials by S. Suresh, Cambridge University Press.
8. Analysis of Metallurgical Failures, by V. J. Colangelo, F. A. Heiser (Wiley).

Course Outcomes: Upon completion of this class, students are expected to

1. Understand the basic fundamentals of mechanism of fracture, fatigue and creep and associated terms and related equations and analyse the various metallurgical factors.
2. Understand and identification of modes and root cause of failures in different industrial problems and their solutions.
3. Selection and Application of suitable remedial measure to prevent premature failure and reduction in performance.

MME206	Tribology of Materials	3-0-0	Credits 3

Objectives of the course: To understand the basic principles of friction, wear and lubrication and terminology associated with tribology of materials and to understand the issues associated with tribological applications of these materials.

MODULE-I **(14 Hours)**

Background and importance of Tribology; A system approach to Tribology; Characterization of tribosurfaces; mechanics of solid contacts; Hertzian and non-hertzian contact. Contact pressure and deformation in non-conformal contacts, friction in contacting rough surfaces, sliding and rolling friction, various laws and theory of friction and frictional heat generation; role of contact temperature.

MODULE-II **(14 Hours)**

Different modes of wear; Wear and wear types. ; Mechanisms of wear - Adhesive, Abrasive, corrosive, erosion, fatigue, fretting, etc., Wear of metals and non-metals. Wear models - asperity contact, constant and variable wear rate, geometrical influence in wear models, wear damage. Wear in various mechanical components, wear controlling techniques.Tribological testing techniques and analysis of the worn surfaces.

MODULE-III **(14 Hours)**

Different wear resistant materials; recent research results illustrating the performance of surface coatings, bulk materials and composite materials in tribological contacts. Lubrication; Importance and properties of lubricants.

Books for reference:

1. Friction, Wear, Lubrication - A Text book in Tribology, by K.C. Ludema, CRC press.
2. Materials and Surface Engineering in Tribology by Jamal Takadoum.
3. Tribology by Hutchins.
4. Principle and Application of Tribology by Bharat Bhusan, wiley McGraw-Hill.
5. Introduction to Tribology by Bharat Bhusan, wiley McGraw-Hill.

Course Outcomes: Upon completion of this class, students are expected to

1. Understand the terminologies used in the surface profiles of tribology of materials
2. Understand the basic principles of different methods of friction, wear and lubrication of materials.
3. Understand the selection and identification of materials for different industrial problems and applications
4. Understand the different issues related to tribology of materials

MMC203	Materials Testing Lab	0-0-4	Credits 2

Objectives of the course: To demonstrate the different testing methods qualitatively as well as quantitatively to determine the properties of materials.

List of suggested experiments:

1. To determine the Vickers Hardness Number of the given Samples.
2. To determine the Brinell Hardness Number of the given Samples.
3. To determine the Rockwell Hardness of the given samples.
4. To determine the impact strength of the given samples by Charpy and Izod Impact Tests.
5. To determine the tensile properties of the given materials using Universal Testing Machine (UTM) – yield strength, tensile strength, % elongation, % reduction of area.
6. To determine the compression strength of the given sample.
7. To determine the fatigue strength of the given sample.
8. To determine the drawability of aluminium / steel sheet by Erichsen cup test.
9. To study the ultrasonic flaw detector and determine the cracks within a sample.
10. To determine the cracks in a sample using the magnetic crack detector.
11. To determine indentation fracture toughness using Vickers indentation
12. To determine the flexural strength using three point and four point bending method.
13. To determine the diametrical tensile strength of ceramics using UTM
14. To determine the toughness of V-notched ceramics using UTM

Course Outcomes: Upon completion of this class, students are expected to

1. Demonstrate the different testing methods of materials as qualitatively and quantitatively using different tools.
2. Selection and identification of materials for different industrial applications.

MMC204	Advanced Materials Processing Lab	0-0-4	Credits 2

Objectives of the course: To demonstrate the different welding and sintering qualitatively as well as quantitatively

List of suggested experiments:

1. To study bead profile, percentage dilution and width of heat affected zone (HAZ) under different arc welding parameters (Heat input).
2. To study microstructure of weld metal and HAZ of steel and aluminium alloys performed under different arc welding parameters (Heat input).
3. To characterize weld defects by DT, Radiography and UT. 7.
4. To study micro hardness testing across weld metal and HAZ of welded steel and aluminium.
5. To develop Weld Procedure Specification (WPS) for different materials.
6. To Effect of compacting pressure on grain density of metal powders.
7. Characteristics features of sintering of metal powder compacts.
8. Metal powder characteristics like bulk density, true density etc.
9. To Synthesis of nano alumina (Al_2O_3) powders by Sol-Gel Processing.
10. To Synthesis of Titanium dioxide (TiO_2) powders by Sol-Gel Processing.
11. To Synthesis of zirconia (ZrO_2) powders by Sol-Gel Processing.
12. To synthesis of calcium titanate ($CaTiO_3$) powders by Sol-Gel Processing
13. To synthesis of barium titanate ($BaTiO_3$) powders by Sol-Gel Processing
14. To synthesis of calcium titanate ($CaTiO_3$) powders using high energy ball mill.
15. To synthesis of calcium titanate ($BaTiO_3$) powders using high energy ball mill.
16. To produce Fe_2O_3 powders using high energy ball mill.
17. To synthesis of hydroxyapatite ($Ca_{10}(PO_4)_6(OH)_3$) by solution precipitation
18. To produces Cu-Zn-NiO alloys using high energy ball mill
19. To produces Fe-C- Si metallic alloys using high energy ball mill
20. To produces Al-Si metallic alloys using high energy ball mill
21. To high entropy alloys using varying alloy addition to Fe, Ni, Ti base metallic materials using induction melting and arc melting.

Course Outcomes: Upon completion of this class, students are expected to

1. Understand the terminologies used in the welding and sintering of materials
2. Demonstrate the different processing methods of materials as qualitatively and quantitatively using different tools.
3. Selection and identification of materials for different industrial applications

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

M.TECH SYLLABUS for *Specialization*: METALLURGICAL AND MATERIALS ENGINEERING

BRANCH: METALLURGICAL AND MATERIALS ENGINEERING (2018-19 Admission Batch)

3rd Semester

MME301	Modelling and Computer Application in Metallurgy	3-0-0	Credits 3

Objectives of the course: To understand the fundamentals of modeling, Analysis and curve fitting techniques used for different metallurgical processes.

MODULE-I **(14 Hours)**

Fundamentals of Modeling, processes modeling and physical modeling. Numerical methods for Solution of ordinary differential equations. Application of regression analysis and curve fitting Techniques.

MODULE-II **(14 Hours)**

Calculation of phase diagrams, stereographic projections. Computer applications for energy & material balance in B.F. and BOF Steel making processes.

MODULE-III **(14 Hours)**

Numerical solution of partial differential equations pertinent to heat, mass & momentum transfer. Computer applications in solidification, potential energy diagrams and experiments in metallurgy. Analysis of test data using softwares.

Reference Books:

1. Chapra S.C. and Canale S.C., Numerical Methods for Engineers, Tata McGraw Hill.
2. Szekley J.S., Evans J.W. and Brimakombe J.K., The Mathematical and Physical Modelling of Primary Metals Processing Operations, Wiley

Course Outcomes: Upon completion of this class, students are expected to

1. Understand the fundamentals of modelling and application of regression analysis with appropriate equations.
2. Understand the basic numerical methods and their solutions for different metallurgical problems.
3. Selection and identification of modelling and numerical methods for different industrial applications.

MME302	Physics of Materials	3-0-0	Credits 3

Objectives of the course: To understand the basic principles of free electron theory and semiconducting, magnetics and superconductivity properties of materials.

MODULE-I **(14 Hours)**

Review of electron theory of metals, electrical and thermal conductivity. Theory of electron conduction, temperature dependence of electrical conductivity, Hall effect. Elemental and compound semiconductors and their applications. Processing of semiconductors. Fabrication of semiconductor materials and devices. Application of semiconductors. p-n junction and Schottky barrier transistors etc.

MODULE-II **(14 Hours)**

Thermoelectric properties of metals and semiconductors, ionic and superionic conductivity in solids.

Different types of dielectric materials, ferro, antiferro and ferri-electric materials. Piezo electric materials.

MODULE-III **(14 Hours)**

Magnetic Materials: Theory of magnetism, Dia, Para and Ferro magnetic materials, antiferromagnetism, ferrimagnetism. Soft magnetic materials. Silicon steels. Super conductivity, B.C.S, theory, High temperature super conductivity. Super conducting materials.

References:

1. The Science & Engineering of Microelectronic Fabrication, by S. Campbell, Oxford.
2. Modular Series and Solid state Devices, Vols. 1-5, by Pierret/ Neudeck, Addison-Wesley.
3. Electronic Materials Science and Technology, S.P. Mauraka and M.C.Peckrar, Academic Press.
4. Introduction to Superconductivity, by A.C.Rose-innes and E.H.Rhoderick, Pergamon press, Oxford.
5. Science of Engineering Materials, by C.M.Srivastava and C.Srinivasan, New Age Pub., New Delhi.
6. Superconductivity, Academic Press.
7. Introduction to Solid State Physics, by C.Kittel, John Wiley.
8. Solid State Electronic Devices, by B.G.Streetman, Prentice Hall, New Delhi.
9. Modern Ferrite Technology, by A.Goldman, Van Nostrand, New York

Course Outcomes: Upon completion of this class, students are expected to

1. Understand the terminologies used in the free electron theory of metals.
2. Understand the basic principles of magnetic, semi conductivity and superconductivity of materials.
3. Selection and application of materials for different industrial applications.
4. Understand the different issues related to high temperature super conductivity of materials.

MME303	Energy conservation and pollution control in Metallurgical Industries	3-0-0	Credits 3

Objectives of the course: To understand the fundamentals of energy conservation and pollution control used for different metallurgical processes.

MODULE-I **(14 Hours)**

Forms of energy, energy conversion, energy sources and resources, Review of commercial energies from solid, liquid and gaseous fuels,

MODULE-II **(14 Hours)**

Nuclear energy systems, Improving energy efficiency in extractive metallurgical processes,

MODULE-III **(14 Hours)**

Recycling of energy, Gas recovery in metal processing industries, gas cleaning and removal of particulate matter from gases.

Reference Books:

1. Harker and Backhurst, Fuel and Energy, Academic Press, London, 1981.
2. C. B. Gill, Non-Ferrous Extractive Metallurgy, John Wiley, 1980.
3. S. P. Mahajan, Pollution Control in Process Industries, Tata McGraw Hill, 1985.

Course Outcomes: Upon completion of this class, students are expected to

1. Understand the fundamentals of energy conversion and recovery of gases in different industrial applications. Compare the energy source like liquid, solid and gases.
2. Understand the basic pollution control methods and their solutions for different metallurgical industries.
3. Selection and identification of energy conversion sources and pollution control techniques for different industrial applications.

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

M.TECH SYLLABUS for *Specialization*: INDUSTRIAL METALLURGY

BRANCH: METALLURGICAL AND MATERIALS ENGINEERING (2018-19 Admission Batch)

First Semester				Second Semester			
Theory				**Theory**			
Course Code	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**	**Course Code**	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**
	Programme Core-1	3-0-0	3		**Programme Core-3**	3-0-0	3
IMC101	Principles of Extractive Metallurgy			IMC201	Advanced Casting Processes		
	Programme Core-2	3-0-0	3		**Programme Core-4**	3-0-0	3
MMC102	Advanced Metallurgical Thermodynamics and Kinetics			MMC202	Characterization of Materials		
	Programme Elective-1 (Any One)	3-0-0	3		**Programme Elective-3 (Any One)**	3-0-0	3
IME101	Advances in Iron and Steel Making			IME201	Non Destructive Testing		
IME102	Composite Materials			IME202	Powder Metallurgy		
IME103	High Temperature Materials			IME203	Mechanical Working of Materials		
	Programme Elective-2 (Any One)	3-0-0	3		**Programme Elective-4 (Any One)**	3-0-0	3
IME104	Mineral Beneficiation			IME204	Electrochemistry and Corrosion		
IME105	Non Ferrous Extractive Metallurgy			MME206	Tribology of Materials		
IME106	Theory and Practice of Sintering			IME205	Industrial Heat Treatment		
					Audit Course-2 (Any One from the list of Audit Courses)	2-0-0	0
GHM101	Research Methodology & Intellectual Property Rights	2-0-0	2				
	Audit Course-1 (Any One from the list of Audit Courses)	2-0-0	0				
	Total (Theory)	**16**	**14**		**Total (Theory)**	**14**	**12**
	Practical/ Sessional				**Practical/ Sessional**		
	Lab-1	0-0-4	2		**Lab-3**	0-0-4	2
IMC102	Extractive Metallurgy and Thermodynamics Lab.			IMC202	Materials Characterization Lab.		
	Lab-2	0-0-4	2		**Lab-4**	0-0-4	2
IMC103	Mineral Beneficiation Lab.			IMC203	Advanced Materials Processing Lab		
				IMJ201	**Mini Project with Seminar**	0-0-4	2
	Total (Practical/ Sessional)	**8**	**4**		**Total (Practical/ Sessional)**	**12**	**6**
	TOTAL	**24**	**18**		**TOTAL**	**26**	**18**
TOTAL SEMESTER CREDITS: 18				TOTAL SEMESTER CREDITS: 18			
TOTAL CUMULATIVE CREDITS: 18				TOTAL CUMULATIVE CREDITS: 36			

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

M.TECH SYLLABUS for *Specialization*: INDUSTRIAL METALLURGY

BRANCH: METALLURGICAL AND MATERIALS ENGINEERING (2018-19 Admission Batch)

Third Semester				Fourth Semester			
Theory				**Theory**			
Course Code	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**	**Course Code**	**Course Name**	**L-T-P (Periods/ Week)**	**Credits**
	Programme Elective-5 (Any One)	3-0-0	3				
IME301	Pollution control and waste management in Iron and Steel Industries						
IME302	Secondary Steel Making						
IME303	Surface Engineering						
	Open Elective (Any One)	3-0-0	3				
	Business Analytics						
	Industrial Safety						
	Operations Research						
	Cost Management of Engineering Projects						
	Composite Materials						
	Waste to Energy						
	Internet of Things						
	Soft Computing						
	Project Engineering & Management						
	Start-up & Entrepreneurship Development						
	Total (Theory)	**6**	**6**		**Total (Theory)**	**0**	**0**
	Practical/ Sessional				**Practical/ Sessional**		
IMJ301	Dissertation Phase-I	0-0-20	10	IMJ401	Dissertation Phase-II	0-0-32	16
	Total (Practical/ Sessional)	**20**	**10**		**Total (Practical/ Sessional)**	**32**	**16**
	TOTAL	**26**	**16**		**TOTAL**	**32**	**16**
TOTAL SEMESTER CREDITS: 16				TOTAL SEMESTER CREDITS: 16			
TOTAL CUMULATIVE CREDITS: 52				TOTAL CUMULATIVE CREDITS: 68			

List of Audit courses

1. AHM101 English for Research Paper Writing
2. ACE101 Disaster Management
3. AHM102 Sanskrit for Technical Knowledge
4. AHM103 Value Education
5. AHM104 Constitution of India
6. AHM105 Pedagogy Studies
7. AHM106 Stress Management by Yoga
8. AHM107 Personality Development through Life Enlightenment Skills

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

M.TECH SYLLABUS for *Specialization*: INDUSTRIAL METALLURGY

BRANCH: METALLURGICAL AND MATERIALS ENGINEERING (2018-19 Admission Batch)

1st semester

IMC101	Principles of Extractive Metallurgy	3-0-0	Credits 3

Objectives of the course:

1. This course will extend the concepts of beneficiation as well as thermodynamics and kinetics to different processes for extraction of metals.

MODULE-I **(14 Hours)**

Introduction: Scope of extractive Metallurgy, Occurrence of Metals in Nature, Ellingham diagrams for oxides and sulphides. Introduction to mineral beneficiation, sampling, liberation studies and its importance. Unit operation of Comminution, Grinding, Size separation, Classification, Concentration, Froth flotation, Magnetic and electrostatic separation, Dewatering and drying

MODULE-II **(14 Hours)**

Pyrometallurgy: Ore preparation, Calcination, Roasting, Predominance area diagram, Roasting and Ores, Elementary concepts of extraction of Metals from their ores. Ellingham practice, Reduction smelting, Matte smelting, Converting, Role of Slags. Refining Methods: Fire refining, Liquation, Poling, Cupellation, Vacuum distillation, Zone refining, Electrolytic refining.

Hydrometallurgy: Ore preparation, Leaching practice, Bio leaching, Kinetics of leaching, Role of oxygen in leaching, Recovery of metals from leach liquor by solvent extraction, ion exchange, precipitation, cementation and electro winning methods.

MODULE-III **(14 Hours)**

Electrometallurgy: Theory of electrodeposition, Faraday's Laws, Electrode potential, EMF series, Nernst equation, Hydrogen over voltage, Electro winning, Pourbaix diagram. Calculation of material and heat balances pertaining to some important metal extraction process.

Flow sheets: Typical flow sheets for beneficiation of iron, gold, copper, lead-zinc sulphide ores, rock phosphate, beach sand, uranium and other industrial minerals. Problems related to the process metallurgy.

Text/Reference Books:

1. Newton J., Extractive Metallurgy, Wiley.
2. Gilchrist J.D., Extraction Metallurgy, Pergamon.
3. Rosenqvist T., Principles of Extractive Metallurgy, McGraw Hill.
4. Ghosh Ahindra, Chatterjee A., Ironmaking and Steelmaking Theory and Practices, PHI Pvt. Ltd.

Course Outcomes: At the end of the course, the student should be able to

1. Apply principles of thermodynamics and kinetics to reactions involving extraction of metals

2. Analyse different extraction processes
3. Solve numerical problems involving thermodynamic and kinetic concepts of relevance to extractive metallurgy

MMC102	Advanced Metallurgical Thermodynamics and Kinetics	3-0-0	Credits 3

Objectives of the course:

1. This course will extend the students the knowledge on material thermodynamics and to provide them explaining and applying the thermodynamic laws on metallurgical systems.

MODULE-I **(14 Hours)**

General principles: first and second law, mathematical formalism for the thermodynamic description of closed systems with constant composition. Mathematical formalism for the thermodynamic description of systems with variable composition. The chemical potential. Partial properties. Relation between integral and partial molar properties. Chemical potential of ideal gases (pure and mixtures) and non-ideal gases (pure and mixtures).

MODULE-II **(14 Hours)**

Chemical potential of pure liquids and solids and of components in liquid and solid solutions. The activity concept. Standard states and activities. Ideal solutions and non-ideal solutions. Activity coefficients.

Properties of solutions. Simple solution models. Introductory concepts of statistical thermodynamics. The regular solution model. Phase stability and phase diagrams. Reaction equilibrium, oxidation and reduction, Ellingham diagrams Thermodynamics vs. kinetics, homogeneous and heterogeneous reactions; Chemical Reaction Control-rate equation, reaction rate constant, reaction order, non-elementary reactions;

MODULE-III **(14 Hours)**

Solid State Diffusion -Fick's Law, mechanism of diffusion, uphill diffusion, Kirkendall effect, steady and transient diffusion;External Mass Transfer -fluid flow and its relevance to mass transfer, general mass transport equation, concept of mass transfer coefficient, models of mass transfer -film theory and Higbie's penetration theory; Internal Mass Transfer-Ordinary and Knudsen diffusion, Mass transfer with reaction; Adsorption –physical adsorption vs. chemisorption, adsorption isotherms; Langmuir, BET, adsorption as the rate limiting step; gasification of C by CO2, dissolution of N2 in molten steel, porous solids, specific surface area and pore size distribution;

Applications in extractive metallurgy, e.g. iron and steel making, copper making

Applications in physical metallurgy, e.g. solid phase transformations and equilibria in metallic alloys, cemented carbides etc.

Text/Reference Books:

1. Metallurgical Thermodynamics, Gaskell

2. Ragone, David V. Thermodynamics of Materials. Vol. 1. New York, NY: Wiley,
3. Porter, David A., and K. E. Easterling. Phase Transformations in Metals and Alloys. 2nd ed. New York, NY: Chapman & Hall,
4. Balluffi, Robert W., Samuel M. Allen, and W. Craig Carter. Kinetics of Materials. Hoboken, NJ: J. Wiley & Sons,

Course Outcomes: At the end of the course, the student should be able to

1. Practice the laws of thermodynamics in metallurgical reactions.
2. Analyze the systems from the viewpoint of free energy and entropy.
3. Practice thermodynamic applications of Ellingham diagram.

IME101	Advances in Iron and Steel Making	3-0-0	Credits 3

Objectives of the course:

1. To provide students with wider theoretical knowledge of production of iron and steel with a focus on basic chemical, thermal and physical phenomena along with advancements in processes involved in iron and steel making.

MODULE-I **(14 Hours)**

Blast furnace profile, Modern trends in Blast furnace

Sponge Iron making: Coal based processes: Rotary kiln process, Rotary hearth furnace process (Fastmet process, ITmk3 process). Gas based processes –Finmet process, Midrex process, HYL processes (HYL -III & HYL –IVM processes).

Smelting Reduction (SR): Fundamental of SR, Classification and important SR processes: COREX process, Finex process, Hismelt process, Romelt process.

MODULE-II **(14 Hours)**

Principles and practice of Duplex process for stainless steel making in AOD and VOD,

Ladle Metallurgy: Construction and Operation of LRF, Use of complex deoxidizers, deoxidation practices, Non-Metallic inclusions, Inclusion Engineering, gases in steel and degassing technology

MODULE-III **(14 Hours)**

Hybrid Steel making processes, Continuous steel making processes: WOCRA, IRSID, Spray steel making.environmental pollution in iron and steel industries

Text/Reference Books:

1. Biswas A.K., Principles of Blast Furnace Iron Making, SBA.

2. Ghosh Ahindra, Chatterjee A., Iron making and Steelmaking Theory and Practices, PHI Pvt. Ltd.
3. Tupkary R.H., Introduction to Modern Iron Making, Khanna Publishers
4. Gupta S.S. and Chatterjee A., Blast Furnace Iron Making, SBA New Delhi.
5. Tupkary R.H., An Introduction to Modern Steel Making, Khanna Publishers.
6. G.R. Bashforth, The Manufacture of Iron and Steel, Chapman & Hall.
7. Edneral F.P., Electrometallurgy of Steel and Ferroalloys, Vol. 1&2, Mir.

Course Outcomes: At the end of the course, the student should be able to

1. Practice basic theoretical knowledge and technological principles in iron and steel production.
2. Analyses the process variable of iron and steel making to achieve the optimum processing window.
3. Solve numerical problems involving raw materials, deoxidation and degassing.
4. Formulate ways for energy conservation and environmental pollution control.

IME102	Composite Materials	3-0-0	Credits 3

Objectives of the course:

1. To acquire. in-depth understanding of different types of composite materials along with their properties and processing for various engineering applications.

MODULE-I **(12 Hours)**

Introduction: Definition, classification, properties, applications, advantages and limitations of composites, Types of matrix and reinforcements, and their properties. Mechanics of Composites, Iso strain and Iso stress conditions, Role of fibers, Critical fiber length.

MODULE-II **(16 Hours)**

Fabrication of Polymer Matrix Composites (PMCs): Properties, Applications and Limitations of PMCs; Various fabrications methods- Filament winding; Resin injection moulding; extrusion, calendering, pultrusion, degradation of fibers. Sandwich structures, foam core type arrangements; Honey comb structures. Hand Layup technique, Spray Up Technique, Filament welding, Pultrusion, Autoclave based methods, Injection moulding, Extrusion.

Fabrication of Metal Matrix Composites (MMCs): Properties, Applications of MMCs; Fabrications methods: Liquid methods- Duralcan process, Spray forming, Squeeze casting, Stir casting; Solid state process- Diffusion bonding.

MODULE-III **(14 Hours)**

Fabrication of Ceramic Matrix Composites (CMCs): Properties, Applications and limitations of CMCs; Various fabrications methods: Cold pressing and sintering, Hot pressing, Liquid infiltration, Lanxide process. Fabrication of Carbon-Carbon Composites (CCCs): Properties, Applications and limitations of CCCs;

Processing of CCC- Solid, Liquid and Gas phase pyrolysis processes.

Text/Reference Books:

1. Materials Science and Engineering: An Introduction - William D Callister Jr
2. Composite materials, K.K. Chawala; 2nd ed., Springer-Verlag, 1987.
3. Nanocomposite Science and Technology, P. M. Ajayan, L. S. Schadler, P. V. Braun; Wiley-VCH Verlag GmbH Co, 2013.
4. Mechanics and Analysis of Composite Materials, V.V. Vasiliev, E.V. Morozov; Elsevier Science Ltd, 2001.
5. Ceramic matrix composites, K.K. Chawala; 1st ed., Chapman & Hall,1993.
6. Advances in composite materials, G. Piatti Applied Science Publishers Ltd., 1978.
7. Composite Materials, Mel. M. Schwartz; Vol 1 & 2, Prentice - Hall PTR, 1997.
8. Advanced Polymer composites, BorZ.Jang; ASM International,1994

Course Outcomes: At the end of the course, the student should be able to

1. Synthesise different composites and alnalyse their properties for diffeent applications
2. Analyse the benefits and disadvantages of using composites in aerospace structures
3. Calculate the mechanical properties of various composites with the help of theoretical knowledge.
4. Analyse and select the optimum processing window for fabricating composite components.

IME103	High Temperature Materials	3-0-0	Credits 3

Objectives of the course:

1. This course offers new ideas, insights and results related to high-temperature materials and processes in science and technology.

MODULE-I **(14 Hours)**

Introduction: Need for High Temperature Materials, High Temperature Materials, Historical Development of High Temperature Materials. Requirements of High Temperature Materials: Environmental Resistance, Oxidation, Sulphidation, Salt- and Ash-Deposit Corrosion. carburisation, Erosion, Wear, Mechanical Behaviour, Zero Time Deformation, Creep, Mechanical Fatigue, Thermo-Mechanical Fatigue, Corrosion-Fatigue, Physical Properties.

MODULE-II **(14 Hours)**

Increasing Temperature Capability: Metallic Materials, Solid Solution Strengthening, Precipitation Strengthenin, Dispersion Strengthening. Grain Size and Grain Boundary Effects, Environmental Resistance, Ceramic Materials, Manufacture, Properties, Alumina, Zirconia, Silicon Carbide, Silicon Nitride, Glass Ceramics. Phase Control, Defect Tolerance, Thermal Shock Resistance, Composite Materials, Metal Matrix

Composites, Titanium Matrix Composites, Carbon and Carbon-Carbon Composites, Ceramic Matrix Composites

Intermetallic Matrix Composites.

MODULE-III **(14 Hours)**

Ferritic Heat Resistant Materials, Creep Resisting Martensitic Steels, Austenitic Steels, Corrosion Resistant Austenitic Steels, High Strength Austenitic Steels, Controlled Transformation Stainless Steels, Grey Cast Irons.

Spheroidal Graphite Irons Austenitic Irons. Oxidation and Corrosion Resistant Nickel Alloys, Nickel Superalloys, Cobalt Alloys, Refractory Metals, Titanium alloys, Titanium Aluminides, Nickel Aluminides, Iron Aluminides, Speculative Intermetallics, Cemented Carbide Cutting Tools, Wear Resistant Coatings. Corrosion/Oxidation Resistant Coatings, Thermal Barrier coats.

Text/Reference Books:

1. Geoffrey W. Meetham, Prof. Dr. ir. Marcel H. Van de VoordeMaterials for High Temperature Engineering Applications, Springer-Verlag

Course Outcomes: At the end of the course, the student should be able to

1. Describe degradation of materials at high temperature
2. Analyse and evaluate the synthesis and characteristics of materials for high temperature applications
3. Describe the metallurgy of refractory metals and superalloys

IME104	Mineral Beneficiation	3-0-0	Credits 3

Objectives of the course:

1. To study the various aspects pertaining to enhancement of ore grades and also to establish the appropriate methods/techniques for eco-friendly exploitation of different ore deposits for economic extraction of metals.

MODULE-I **(14 Hours)**

Introduction to mineral beneficiation, sampling, liberation studies and its importance.

Comminution: Laws of comminution, Crushing: construction and operational features of jaw, gyratory, cone, roll crushers, Hammer mills and Rotary breakers. Grinding: Grinding mill principles, Ball mill, Rod mill, Pebble mill and Autogenous mills. Recent development in comminution. Size separation: Sieving and screening, laboratory sizing and its importance, representation and interpretation of size analysis data, industrial screening.

Classification: free and hindered settling of particles, Construction, operation and maintenance application of different types of classifiers.

MODULE-II **(14 Hours)**

Concentration: Gravity separation, concentration criteria, jigging, Spirals, flowing film concentration and tabling, dense media separation. Advanced Gravity Separators. Froth flotation: Theory, reagents used in floatation processes, machines and practice. Magnetic and electrostatic separation: Theory and application of advanced magnetic and electrostatic separation techniques in mineral industry. Dewatering and drying: Theory and practice of thickening; filtration and drying.

MODULE-III **(14 Hours)**

Flow sheets: Typical flow sheets for beneficiation of iron, gold, copper, lead-zinc sulphide ores, rock phosphate, beach sand, uranium and other industrial minerals. Agglomeration techniques: Sintering, pelletizing, briquetting and their applications in ferrous and nonferrous metal industries, testing of agglomerates.

Text/Reference Books:

1. Gaudin A. M., Principle of Mineral Dressing.
2. Richards R. H. and Locks C. E., Text Book of Ore Dressing.
3. Taggart A.E., Element of Ore Dressing.
4. Taggart A.E., Handbook of Mineral Dressing- Ores and Industrial Minerals.
5. Trusscott S.J., Textbook of Ore Dressing.
6. Jain S.K., Ore Dressing.
7. Willis Berry A, Mineral Processing Technology

Course Outcomes: At the end of the course, the student should be able to

1. Formulate advanced skills in modification of process flow sheets.
2. Apply theoretical knowledge in prudential utilization and conservation of mineral resources,
3. Analyse innovations in feasible techniques for optimization of production, energy consumption and environmental pollution control etc.

IME105	Non Ferrous Extractive Metallurgy	3-0-0	Credits 3

Objectives of the course:

1. This course will extend the concepts of thermodynamics and kinetics to different processes for extraction of metals.

MODULE-I **(14 Hours)**

Extraction of metals from oxides and sulphides: thermodynamic principles, Ellingham diagrams, metallothermic reduction.

General methods of extraction: Pyro-metallurgy: calcinations, roasting and smelting,

Hydrometallurgy: leaching, solvent extraction, ion exchange, precipitation, and Electrometallurgy: electrolysis and electro-refining.

MODULE-II **(14 Hours)**

Aluminium: Bayer's process and factors affecting its operation, Hall- Heroult process: Principle and practices, anode effect, refining of aluminium. Alternate methods of production of alumina and aluminium.

Copper: roasting of sulphides, matte smelting, converting; refining, by-products recovery; recent developments, continuous copper production processes, hydrometallurgy of Copper.

Zinc: principle and practices of roasting, sintering and smelting; Hydrometallurgy of Zinc.

Lead: agglomeration of galena concentrates and roasting, blast furnace smelting, refining of lead bullion.

MODULE-III **(14 Hours)**

Uranium: process for the digestion of uranium ores; purification of crude salts; production of reactor grade UO_2.

Titanium: methods of upgrading Ilmenite; chlorination of Titania, Kroll and Hunter processes; Consolidation and refining.

Other Metals: Simplified flow sheets and relevant chemical principles of extraction of Ni, Mg, Au, Ag, Sn, Zr, Th, Co, W and, Mo.

Text/Reference Books:

1. Ray H.S., Sridhar R. & Abraham K.P., Extraction of Non Ferrous Metals, Affiliated East West.
2. Biswas A.K. & Davenport W.G., Extractive Metallurgy of Copper, Pergamon.
3. Zelikman A.N., Krein O.E. & Samsonov G.V., Metallurgy of Rare Metals, Israel Program for Scientific Translation.
4. Rosenqvist T, Principles of Extractive Metallurgy, Tapir Academic Press, 2004.

Course Outcomes: At the end of the course, the student should be able to

1. Apply principles of thermodynamics and kinetics to reactions involving extraction of metals
2. Analyse different extraction processes
3. Solve numerical problems involving thermodynamic and kinetic concepts of relevance to extractive metallurgy
4. Describe the effect of a change in process parameters of different extraction processes

IME106	Theory and Practice of Sintering	3-0-0	Credits 3

Objectives of the course:

1. To acquire knowledge of science and technology of sintering and their application in engineering materials.

MODULE-I **(14 Hours)**

Science and Technology of the sintering of materials- Driving force and variables, role of defects, Kroger-Vink Notation, diffusion, chemical potential, Ambipolar Diffusion.

Mechanisms of Sintering, Theoretical Analysis of Sintering - Development of scaling laws and their application. Grain Growth and Microstructure Control, Normal and abnormal grain growth, Mechanisms Controlling the Boundary Mobility, Grain Growth and Pore Evolution in Porous Solids, Simultaneous Densification and Grain Growth

MODULE-II **(14 Hours)**

Fabrication Principles for Ceramics/metals with Controlled Microstructure, Microstructure development models and maps, Derivation of sintering and grain growth models and a critical review of their uses and limitations. Mapping approaches. Coverage of single phase, multiphase and composite systems.

Liquid-Phase Sintering- Stages, Thermodynamic And Kinetic Factors, Basic Mechanisms, Use of Phase Diagrams, Activated Sintering, Vitrification, Solid Solution Additives

MODULE-III **(14 Hours)**

Sintering With Chemical Reaction- Reaction Sintering. Viscous sintering, Viscous Sintering with Crystallization, Pressure Sintering, Microwave sintering, Gases in pores and sintering atmospheres, Plasma Sintering, Additive manufacturing,

Case studies of specific ceramic and metal systems

Text/Reference Books:

1. Randall German, Powder Metallurgy Science, Metal Powder Industry; 2 Sub Edition, 1994.
2. Randall German, Powder Metallurgy & Particulate Materials Processing, Metal Powder Industry, 2005
3. M. N. Rahaman, Ceramic Processing and Sintering, 2nd Edition, Marcel Dekker Inc., NY,2003.
4. W.D. Kingery, H.K. Bowen and D.R. Uhlman, Introduction to Ceramics, Ceramic Science and Technology, John Wiley and Sons, Singapore, 1991.
5. M.W. Barsoum, Fundamentals of Ceramics, 2nd Edition, IoP Publications, UK, 2003
6. Randall German, Sintering Theory and Practice, Wiley-Inter science; 1 Edition, 1996.
7. ASM Handbook: Volume 7: Powder Metal Technologies and Applications (Asm Handbook), ASM International; 2nd Edition, 1998.
8. Claus G. Goetzel, Treatise on Powder Metallurgy, VOLUME II, III, Applied and Physical Powder Metallurgy, Interscience Publishers Inc., New York, 1950

Course Outcomes: At the end of the course, the student should be able to

1. Control the various processing parameters so as to control the microstructure developed during sintering
2. Apply the various densifying and non-densifying mechanisms to control density/porosity
3. Select appropriate method of sintering for required applications.
4. Develop correlations between structure and properties.

IMC102	Extractive Metallurgy and Thermodynamics Lab	0-0-4	Credits 2

Objectives of the course:

1. To analyse process metallurgy qualitatively as well as quantitatively

List of suggested experiments:

1. Isothermal Kinetic study of limestone decomposition.
2. Devolatalization kinetics of Coal.
3. Oxidation of Copper.
4. To study the decomposition of calcium carbonate and determination of equilibrium constant and free energy change.
5. To determine the partial molal volume of each component in a solution of water and ethanol.
6. To study the effect of temperature on % reduction of iron ore pellet.
7. To study the effect of time on % reduction of iron ore pellet
8. Pelletization of iron ore fines, firing of pellets and measurement of their crushing strengths.
9. Dilatometric study of given Al plate sample
10. Thermal analysis of 0. 2% C steel using DSC – TG technique to study Microstructural changes with temperature

Course Outcomes: At the end of the course, the student should be able to

1. Identify and analyse problems associated with process metallurgy
2. Evaluate thermodynamic behaviour of emerging and conventional materials
3. Optimise process variable of metallurgical processes

IMC103	Mineral Beneficiation Lab	0-0-4	Credits 2

Objectives of the course:

1. To study, verify and apply laws of mineral beneficiation processes

List of suggested experiments:

1. Physical examination and identification of minerals.
2. Crushing of ore/ coal in a jaw crusher and to study the size analysis of the product.
3. To study the jaw crusher and determine the actual capacity and reduction ratio.
4. Verification of Rittinger's Law of crushing in a jaw crusher.
5. Crushing of ore/ coal in a roll crusher and to study the size analysis of the product.
6. Crushing of ore/ coal in a gyratory crusher / pulveriser and to study the size analysis of the product.
7. Crushing of ore/ coal in a cone crusher and to study the size analysis of the product.
8. To study the effect of grinding with grinding time in cylindrical ball mill and rod mill.
9. To separate coal from a mixture of coal and stones or quarts by zigging and determine the weight fractions of the products.
10. To separate a mixture of two minerals of different densities by gravity concentration using Wilfley Table and determine the weight and density of each fraction of the products.
11. Beneficiation of ore pulp mix using flotation cell.
12. To separate a mixture of iron and sand using magnetic separator and determine its efficiency.
13. Screening of ore/ coal using vibrating screen and determine its effectiveness.

Course Outcomes: At the end of the course, the student should be able to

1. Practise different laws for mineral beneficiation
2. Calculate efficiency of different communication techniques
3. Analyse role of mineral beneficiation of raw materials for extractive metallurgy

GHM101	Research Methodology & Intellectual Property Rights	2-0-0	Credits 2

MODULE-I **(06 Hours)**

Meaning of research problem, Sources of research problem, Criteria characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.

Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

MODULE-II **(04 Hours)**

Effective literature studies approaches, analysis,

Plagiarism, Research ethics.

MODULE-III **(04 Hours)**

Effective technical writing, how to write report, Paper.

Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

MODULE-IV **(06 Hours)**

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

MODULE-V **(04 Hours)**

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

MODULE-VI **(04 Hours)**

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Text/Reference Books:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science& engineering students'".
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.

5. Mayall, “Industrial Design”, McGraw Hill, 1992.
6. Niebel, “Product Design”, McGraw Hill, 1974.
7. Asimov, “Introduction to Design”, Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “Intellectual Property in New Technological Age”, 2016.
9. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008

Course Outcomes: At the end of the course, students will be able to

1. Understand research problem formulation.
2. Analyze research related information
3. Follow research ethics
4. Understand that today’s world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property.

   Right to be promoted among students in general & engineering in particular.
6. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Audit Courses

AHM101	English for Research Paper Writing	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Understand that how to improve your writing skills and level of readability
2. Learn about what to write in each section
3. Understand the skills needed when writing a Title

   Ensure the good quality of paper at very first-time submission

MODULE-I **(4 Hours)**

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

MODULE-II **(4 Hours)**

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction.

MODULE-III **(4 Hours)**

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

MODULE-IV **(4 Hours)**

key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed whenwriting a Review of the Literature.

MODULE- V **(4 Hours)**

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions.

MODULE-VI **(4 Hours)**

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

Suggested Studies:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book.

4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

ACE101	Disaster Management	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

MODULE-I **(4 Hours)**

Introduction

Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

MODULE-II **(4 Hours)**

Repercussions of Disasters and Hazards:

Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem.

Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

MODULE-III **(4 Hours)**

Disaster Prone Areas In India

Study of Seismic Zones; Areas Prone To Floods And Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics

MODULE-IV **(4 Hours)**

Disaster Preparedness and Management

Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data From Meteorological and Other Agencies, Media Reports: Governmental and

Community Preparedness.

MODULE-V **(4 Hours)**

Risk Assessment

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategiesfor Survival.

MODULE-VI **(4 Hours)**

Disaster Mitigation

Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation In India.

Text / Reference Books:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies, NewRoyal book Company.
2. Sahni, Pardeep Et.Al. (Eds.), "Disaster Mitigation Experiences and Reflections", Prentice Hall Of India, New Delhi.
3. Goel S. L, Disaster Administration And Management Text And Case Studies" ,Deep &Deep Publication Pvt. Ltd., New Delhi.

AHM102	Sanskrit for Technical Knowledge	2-0-0	Credits 0

Course Objectives:

1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. Learning of Sanskrit to improve brain functioning
3. Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power
4. The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature

MODULE-I **(8 Hours)**

- Alphabets in Sanskrit
- Past/Present/Future Tense
- Simple Sentences

MODULE-II **(8 Hours)**

- Order
- Introduction of roots
- Technical information about Sanskrit Literature

MODULE-III **(8 Hours)**

- Technical concepts of Engineering-Electrical, Mechanical,Architecture, Mathematics

Suggested reading:

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

Course Output: Students will be able to

1. Understanding basic Sanskrit language
2. Ancient Sanskrit literature about science & technology can be understood
3. Being a logical language will help to develop logic in students

AHM103	Value Education	2-0-0	Credits 0

Course Objectives: Students will be able to

1. Understand value of education and self- development
2. Imbibe good values in students
3. Know about the importance of character

MODULE-I **(6 Hours)**

- Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism.
- Moral and non- moral valuation. Standards and principles.
- Value judgements

MODULE-II **(6 Hours)**

- Importance of cultivation of values.
- Sense of duty.Devotion, Self-reliance.Confidence, Concentration. Truthfulness, Cleanliness.
- Honesty, Humanity.Power of faith, National Unity.
- Patriotism.Love for nature, Discipline

MODULE-III **(6 Hours)**

- Personality and Behavior Development - Soul and Scientific attitude.
- Positive Thinking. Integrity and discipline.
- Punctuality, Love and Kindness.
- Avoid fault Thinking.
- Free from anger, Dignity of labour.
- Universal brotherhood and religious tolerance.
- True friendship.
- Happiness Vs suffering, love for truth.
- Aware of self-destructive habits.
- Association and Cooperation.
- Doing best for saving nature

MODULE-IV **(6 Hours)**

- Character and Competence –Holy books vs Blind faith.
- Self-management and Good health.
- Science of reincarnation.
- Equality, Nonviolence, Humility, Role of Women.
- All religions and same message.
- Mind your Mind, Self-control.
- Honesty, Studying effectively

Text / Reference Books

1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

Course outcomes: Students will be able to

1. Knowledge of self-development
2. Learn the importance of Human values
3. Developing the overall personality

AHM104	Constitution of India	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutionalrole and entitlement to civil and economic rights as well as the emergence of nationhood inthe early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the BolshevikRevolution in 1917 and its impact on the initial drafting of the Indian Constitution.

MODULE-I **(4 Hours)**

- **History of Making of the Indian Constitution:**

  History

  Drafting Committee, (Composition& Working)

MODULE-II **(4 Hours)**

- **Philosophy of the Indian Constitution:**

  Preamble

  Salient Features

MODULE-III **(4 Hours)**

- **Contours of Constitutional Rights & Duties:**

  Fundamental Rights

  Right to Equality

  Right to Freedom

  Right against Exploitation

  Right to Freedom of Religion

  Cultural and Educational Rights

  Right to Constitutional Remedies

Directive Principles of State Policy

Fundamental Duties.

MODULE-IV **(4 Hours)**

- **Organs of Governance:**

  Parliament

  Composition

  Qualifications and Disqualifications

  Powers and Functions

  Executive

  President

  Governor

  Council of Ministers

  Judiciary, Appointment and Transfer of Judges, Qualifications

  Powers and Functions

MODULE-V **(4 Hours)**

- **Local Administration:**

  District's Administration head: Role and Importance,

  Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation.

  Pachayati raj: Introduction, PRI: Zila Pachayat.

  Elected officials and their roles, CEO Zila Pachayat: Position and role.

  Block level: Organizational Hierarchy (Different departments),

  Village level: Role of Elected and Appointed officials,

  Importance of grass root democracy

  Model Curriculum of Engineering & Technology PG Courses [Volume -II]

MODULE-VI **(4 Hours)**

- **Election Commission:**

  Election Commission: Role and Functioning.

  Chief Election Commissioner and Election Commissioners.

  State Election Commission: Role and Functioning.

  Institute and Bodies for the welfare of SC/ST/OBC and women.

Text / Reference Books:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn, Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Outcomes: Students will be able to:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the passage of the Hindu Code Bill of 1956.

AHM105	Pedagogy Studies	2-0-0	Credits 0

Course Objectives: Students will be able to:

1. Review existing evidence on the review topic to inform programme design and policymaking undertaken by the DfID, other agencies and researchers.
2. Identify critical evidence gaps to guide the development.

MODULE-I **(4 Hours)**

- **Introduction and Methodology:**
- Aims and rationale, Policy background, Conceptual framework and terminology
- Theories of learning, Curriculum, Teacher education.
- Conceptual framework, Research questions**.**
- Overview of methodology and Searching.

MODULE-II **(2 Hours)**

- Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries.
- Curriculum, Teacher education.

MODULE-III **(4 Hours)**

- Evidence on the effectiveness of pedagogical practices
- Methodology for the in depth stage: quality assessment of included studies.
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?
- Theory of change.
- Strength and nature of the body of evidence for effective pedagogical practices.
- Pedagogic theory and pedagogical approaches.
- Teachers' attitudes and beliefs and Pedagogic strategies.

MODULE-IV **(4 Hours)**

- Professional development: alignment with classroom practices and follow up support
- Peer support
- Support from the head teacher and the community.
- Curriculum and assessment
- Barriers to learning: limited resources and large class sizes

MODULE- V **(2 Hours)**

- **Research gaps and future directions**
- Research design
- Contexts
- Pedagogy
- Teacher education
- Curriculum and assessment
- Dissemination and research impact.

Text / Reference Books:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2):245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal ofCurriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International JournalEducational

Development, 33 (3): 272–282.

5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

Course outcomes: Students will be able to understand:

1. What pedagogical practices are being used by teachers in formal and informal classrooms indeveloping countries?
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, andwith what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

AHM106	Stress Management by Yoga	2-0-0	Credits 0

Course Objectives:

1. To achieve overall health of body and mind
2. To overcome stress

MODULE-I **(8 Hours)**

- Definitions of Eight parts of yoga. (Ashtanga)

MODULE-II **(8 Hours)**

- Yam and Niyam.

  Do`s and Don't's in life.

  i) Ahinsa, satya, astheya, bramhacharya and aparigraha

  ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

MODULE-III **(8 Hours)**

- Asan and Pranayam

  i) Various yog poses and their benefits for mind & body

  ii) Regularization of breathing techniques and its effects-Types of pranayam

Text / Reference Books:

1. 'Yogic Asanas for Group Tarining-Part-I" :Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

Course outcomes: Students will be able to:

1. Develop healthy mind in a healthy body thus improving social health also
2. Improve efficiency

AHM107	Personality Development through Life Enlightenment Skills	2-0-0	Credits 0

Course Objectives:

1. To learn to achieve the highest goal happily
2. To become a person with stable mind, pleasing personality and determination
3. To awaken wisdom in students

MODULE-I **(8 Hours)**

Neetisatakam-Holistic development of personality

- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)
- Verses- 52,53,59 (dont's)
- Verses- 71,73,75,78 (do's)

MODULE-II **(8 Hours)**

Approach to day to day work and duties.

- Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48,
- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,
- Chapter 18-Verses 45, 46, 48.

MODULE-III **(8 Hours)**

Statements of basic knowledge.

- Shrimad Bhagwad Geeta: Chapter 2-Verses 56, 62, 68
- Chapter 12 -Verses 13, 14, 15, 16,17, 18
- Personality of Role model. Shrimad Bhagwad Geeta: Chapter 2-Verses 17, Chapter 3-Verses 36,37,42,
- Chapter 4-Verses 18, 38,39
- Chapter18 – Verses 37,38,63

Text / Reference Books:

1. "Srimad Bhagavad Gita" by Swami SwarupanandaAdvaita Ashram (PublicationDepartment), Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

Course outcomes: Students will be able to:

1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achievethe highest goal in life
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity
3. Study of Neetishatakam will help in developing versatile personality of students.

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

M.TECH SYLLABUS for *Specialization*: INDUSTRIAL METALLURGY

BRANCH: METALLURGICAL AND MATERIALS ENGINEERING (2018-19 Admission Batch)

2nd Semester

IMC201	Advanced Casting Processes	3-0-0	Credits 3

Objectives of the course: To give the students a broad overview to various aspects of Advanced casting process. Instill interest and curiosity in the discipline.

MODULE-I **(14 Hours)**

Principles of casting design, pattern design considerations, pattern allowances, pattern design and construction. Features of moulding processes, equipments, mechanizations, forces acting on moulds, mould factors in metal flow, molding factors in casting design.

MODULE-II **(14 Hours)**

Design of different types of cores and core prints Fundamentals of fluid flow, design of gating system, slag traps and filters etc. Types of binders and their uses in mould and core makings. Melting practices as adopted for a few metals and alloys.

MODULE-III **(14 Hours)**

Concept of directional and progressive solidification, Time of solidification and Chivorinov‟s rule, differential methods of feeder design, feeding distance, feeding efficiency, feeder aids. Feeding characteristics of alloys, types of gates and risers, gating ratio. Yield of casting and prescription for its augmentation.

Text/Reference Books:

1. Heine R.W., Lopper C.R. & Rosenthal P.C., Principles of Metal Casting, McGrawHill.
2. Davis, G.J., Solidification in Casting, Applied Sciences.
3. Beeley P.R., Foundry Technology, Butterworth.
4. Kondic V., Metallurgical Principles of Foundry, Edward Arnold

Course Outcomes: Through this course the students should:

1. Have a broad knowledge of the discipline
2. Have an exposure to methods and techniques used in the discipline
3. Understand the flow of courses through the rest of their undergraduate education
4. Develop a preliminary understanding of which courses address which topics in the discipline.

MMC202	Characterization of Materials	3-0-0	Credits 3

Objectives of the course: To obtain knowledge on various structural and microstructural characterization techniques of materials. To study the principles, theory and practice of various characterization techniques

MODULE-I **(14 Hours)**

X ray diffraction Symmetry, Lattice, points groups, Bravais lattices, crystal systems, X-ray generation, Bragg Law, factors influencing intensity, Techniques, Indexing, precise lattice parameter determination, residual stress measurement.

Optical Microscopy: Introduction, Contrast, Magnification, Resolution, Numerical aperture, Coherent and incoherent waves, Rayleigh and Abbe‟s criterion for resolution, Different lens defects, Depth of field, Depth of focus, Bright field microscopy, Dark field microscopy, Phase contrast microscopy, Sample preparation for metallography.

MODULE-II **(14 Hours)**

Scanning electron microscopy: Electron Specimen interaction, Magnification, Resolution, Depth of field, Construction and principles, Contrast, sample preparation, Different detectors, contrast and image quality.

MODULE-III **(14 Hours)**

Transmission Electron Microscopy: Construction and principles, sample preparation, Different modes, lens defects and it correction, principles of Diffraction, Ewald spheres, Indexing, Kikuchi lines, Imaging, application on materials Chemical Characterization: Basic principles of spectroscopic techniques: EDS, WDS, XPS, EELS.

Text/Reference Books:

1. Fundamentals of Light Microscopy and Electronic Imaging : Douglas B. Murphy and Michael Davidson, Wiley-Blackwell, 2012
2. Scanning Electron Microscopy and X-Ray Microanalysis: A Text for Biologists, Materials Scientists, and Geologists by Joseph Goldstein and Dale E. Newbury, Springer 2011
3. Elements of X-ray diffraction: B.D. Cullity, Pearson Education 2014,
4. Electron microscopy and analysis: P. J. Goodhew, J. Humphreys, R. Beanland, 3rd edition, CRC Press 2000.

Course Outcomes: After completing this course the student will be able to:

1. Determine crystal structures of materials
2. Analyse microstructure of materials at different length scales
3. Analyse defects and fracture surfaces of the tested materials
4. Indicate instrumentation associated with and operating principles of various techniques

IME201	Non Destructive Testing	3-0-0	Credits 3

Objectives of the course: To become familiar with NDT techniques and to get exposed to the concept and procedure associated with failure analysis.

MODULE-I **(12 Hours)**

Liquid Penetration Test (LPT) , Magnetic Particle Testing (MPT) and Radiography: Visual examination; liquid penetrant testing – procedure; penetrant testing materials, penetrant testing method –sensitivity; application and limitations; magnetic particle testing; definition and principle; magnetizing technique, procedure, equipment sensitivity and limitation; radiography – basic principle, electromagnetic radiation in film, radiographic imaging, inspection techniques, applications, limitations, real time radiography, safety in industrial radiography.

MODULE-II **(14 Hours)**

Eddy current and ultrasonic techniques: Eddy current testing – principle, instrument techniques, sensitivity application, limitation; ultrasonic testing – basic properties of sound beam, ultrasonic transducers, inspection methods, technique for normal beam inspection, flaw characterization technique, ultrasonic flaw detection equipment modes of display, immersion testing, advantage, limitations; acoustic emission testing – principles of AET and techniques.

MODULE-III **(16 Hours)**

Application of NDT to finished products: and selection of NDT methods – defects like casting

defects, forging and rolling defect, extrusion defect, drawing defect, grinding cracks, heat treating cracks, service defects; selection of NDT methods- VE, LPT, MPT, ECT, RT, UT, AET and thermography; selection of instrumentation for various NDT methods; reliability in NDT. Failure analysis: methodology; approaches, tools and techniques of failure analysis; modes of failure; failure data retrieval; procedural steps for investigation of a failure for failure analysis.

Failure Characterization: Improvements (design, material) derived from failure analysis; two case studies; application of fracture mechanics concepts to design for safety.

Text Books:

1. Baldev Raj, Jayakumar T., Thavasimuthu M., "Practical Non-Destructive Testing", Narosa Publishir 1997.
2. Das A.K., "Metallurgy of Failure Analysis", TMH, 1992.

Reference Books:

1. Hull, "Non-Destructive Testing", ELBS Edition, 1991
2. Halmshaw R., - "Non-Destructive Testing", Edward Arnold.
3. Rolfe T., Barson J., "Fracture and Fatigue Control and Structure – Application of Fracture Mechanics", Prentice Hall.

Course Outcomes:

The student will be able to describe and select specific Non-Destructive techniques to predict maintain and test for reliability/maintainability and quality of equipment, components and/or structures to maintain safe, effective and efficient operation

IME202	Powder Metallurgy	3-0-0	Credits 3

Objectives of the course: This course teaches powder preparation, characterization, compaction and sintering. This knowledge is essential to understand powder metallurgy applications in aerospace, automobile and machining materials.

MODULE-I **(12 Hours)**

Characteristics and testing of metal powders: Sampling, chemical composition purity, surface contamination etc. Particle size and its measurement, Principle and procedure of sieve analysis, microscopic analysis, sedimentation, elutriation, permeability. Adsorption methods and resistivity methods, particle shape, classifications, microstructure. Specific surface area, apparent and tap density, green density, green strength, sintered compact density, porosity, shrinkage.

MODULE-II **(14 Hours)**

Powder manufacture and conditioning: Mechanical methods Machine milling, ball milling, atomization, shotting. Chemical methods, condensation, thermal decomposition, carbonyl reduction by gas-hydride, dehydride process, electro deposition, precipitation from aqueous solution and fused salts, hydrometallurgical method. Physical methods: Electrolysis and atomization processes, types of equipment, factors affecting these processes, examples of powders produced by these methods, applications, powder conditioning, heat treatment, blending and mixing, types of equipment, types of mixing and blending.

MODULE-III **(16 Hours)**

Powder compaction: Pressure-less compaction, slip casting and slurry casting. Pressure compaction lubrication, single ended and double ended compaction, isostatic pressing, powder rolling, forging and extrusion, explosive compaction.

Sintering: Stage of sintering, property changes, mechanisms of sintering, liquid phase sintering and infiltration, activated sintering, hot pressing and Hot Isostatic Pressing HIP, vacuum sintering, sintering furnaces and sintering atmosphere, finishing operations – sizing, coining, repressing and heat treatment.

Applications: Major applications in aerospace. Nuclear and automobile industries. Bearing Materials types, self-lubrication and other types, methods of production, properties, and applications. Sintered Friction Materials-clutches, brake linings, Tool Materials-cemented

Text Books:

1. Sinha A. K., "Powder Metallurgy", Dhanpat Rai& Sons. New Delhi.
2. Ramakrishnan P, "Powder Metallurgy", New-Age International Publishers,1st ed2007

Reference Books:

1. ASM Handbook. Vol.7, "Powder Metallurgy", Metals Park, Ohio, USA, 1990.
2. Animesh Bose., "Advances in Particulate Materials", Butterworth - Heinemann. New Delhi, 1995.
3. Kempton. H Roll, "Powder Metallurgy", Metallurgical Society of AMlE. Mechanics", Prentice Hall.

Course Outcomes:

The student will come to know of the environmental-related technologically/industrial aspects. He will be able to develop sensitivity for the environment and becomes more eco-friendly

IME203	Mechanical Working of Materials	3-0-0	Credits 3

Objectives of the course: To obtain knowledge of various metal working processes. To obtain insight about different mechanical properties of materials under engineering applications

MODULE-I **(14 Hours)**

Classification of forming processes. Fundamentals of metal working – Flow curve for materials, Effect of temperature, strain rate, metallurgical structure, workability and residual stress. Yielding theories, processing maps. Friction in metal working, Lubrication. Rolling - Classification & processes, load, torque, power, variables controlling process, forward slip. Fundamentals of roll pass design, mill type. Rolling practice, adopted for some common products such as slabs, blooms, billets, plates, sheets etc Rolling defects and their control. Forging - Classification & processes, load for circular & rectangular plate

MODULE-II **(16 Hours)**

Extrusion - Classification & processes, force & variables affecting it. Deformation and defects in extrusion Calculation of extrusion pressure under plain strain conditions, production of tubes and Seamless pipes Drawing of Wires and Tubes- Processes, drawing stress. Calculation of drawing loads, drawing defects. Sheet metal Forming- Forming methods, Forming limit criterion, Special Forming techniques in formed products: deep drawing and redrawing. Formability diagrams, Defects in formed products.

MODULE-III **(12 Hours)**

Special forming methods such as high energy forming: explosive forming, electro hydraulic and magnetic

forming processes.

Text / Reference Books:

1. Mechanical Metallurgy by George E Dieter, McGraw-Hill Education; 3 edition June 1986

Course Outcomes: After completing this course, students will hav

1. Knowledge on the load bearing ability of different materials and their response to stress under engineering applications
2. Knowledge of various metal working processes and defect present in them.

IME204	Electrochemistry and Corrosion	3-0-0	Credits 3

Objectives of the course: To familiarize the student with the extent and importance of material degradation. To study various aspects of corrosion and its control.

MODULE-I **(14 Hours)**

Principles of Electro-Chemistry, Electrode Potential, Reference Electrode, Half-cell reaction, Nernst‟s equation, Application of Thermodynamics to Feasibility of corrosion of metals & alloys in various environments, Pourbaix diagram of common metals, Electrolytes, potentiometric and conductometric titration

MODULE-II **(14 Hours)**

Kinetics of Corrosion , Polarization: Activation, Concentration & Resistance Polarization, Overvoltage, Tafel‟s Equation, Corrosion rate determination by Tafel extrapolation & Linear polarization methods, Passivity & passivity breakdown, Cyclic polarization, Evan‟s diagram , Practical applications of polarization diagrams. Forms of Corrosion: Uniform attack, Galvanic, Crevice, pitting, Intergranular, Erosion corrosion, Stressinduced Corrosion: SCC, CF, HIC, Testing slow strain rate & Fracture mechanics K1C.

MODULE-III **(14 Hours)**

Principle of prevention & protection of Corrosion, Anodic protection, Cathodic Protection, Application of Inhibitors, Organic coating & paints, Metallic coating, Anodizing , phosphating, Chromate coating, Atmospheric corrosion & Oxidation at elevated temperature, Factors affecting atmospheric corrosion &remedy, doping of p & n type metallic oxide, various kinetic laws of Oxidation. Microbial corrosion: Accelerated degradation of metals in presence of Aerobic & Anaerobic microorganisms Corrosion for Beneficial purpose: Introduction to Fuel cell & Battery.

Text Books:

1. Corrosion Engineering, Mars. G. Fontana, McGraw Hill Education, 2017

2. Electrochemical Techniques in Corrosion Science and Engineering. R.G. Kelly, J.R. Scully, D.W. Shoesmith, R.G. Buchheit, CRC Press., 2002

Reference Books

1. Corrosion: Metal / Environment Reactions, Volume 1, L.L. Shreir, R.A. Jarman, G.T. Burstein, Butterworth-Heinemann, 1994.
2. Principles and Prevention of Corrosion, Denny A. Jones, Pearson, 1995.

Course Outcomes: After completing this course the student should be able to:

1. Explain the importance of studying corrosion
2. Describe the thermodynamic aspects of corrosion
3. Describe the kinetic aspects of corrosion
4. Indicate the various forms of corrosion

MME206	Tribology of Materials	3-0-0	Credits 3

Objectives of the course: To understand the basic principles of friction, wear and lubrication and terminology associated with tribology of materials and to understand the issues associated with tribological applications of these materials.

MODULE-I **(14 Hours)**

Background and importance of Tribology; A system approach to Tribology; Characterization of tribosurfaces; mechanics of solid contacts; Hertzian and non-hertzian contact. Contact pressure and deformation in non-conformal contacts, friction in contacting rough surfaces, sliding and rolling friction, various laws and theory of friction and frictional heat generation; role of contact temperature.

MODULE-II **(14 Hours)**

Different modes of wear; Wear and wear types. ; Mechanisms of wear - Adhesive, Abrasive, corrosive, erosion, fatigue, fretting, etc., Wear of metals and non-metals. Wear models - asperity contact, constant and variable wear rate, geometrical influence in wear models, wear damage. Wear in various mechanical components, wear controlling techniques. Tribological testing techniques and analysis of the worn surfaces.

MODULE-III **(14 Hours)**

Different wear resistant materials; recent research results illustrating the performance of surface coatings, bulk materials and composite materials in tribological contacts. Lubrication; Importance and properties of lubricants.

Text Books:

1. Friction, Wear, Lubrication - A Text book in Tribology, by K.C. Ludema, CRC press.
2. Materials and Surface Engineering in Tribology by Jamal Takadoum.
3. Tribology by Hutchins.
4. Principle and Application of Tribology by Bharat Bhusan, wiley McGraw-Hill.
5. Introduction to Tribology by Bharat Bhusan, wiley McGraw-Hill.

Course Outcomes: After completing this course the student should be able to

1. Understand the terminologies used in the surface profiles of tribology of materials
2. Understand the basic principles of different methods of friction, wear and lubrication of materials.
3. Understand the selection and identification of materials for different industrial problems and applications
4. Understand the different issues related to tribology of materials

IME205	Industrial Heat Treatment	3-0-0	Credits 3

Objectives of the course: The heat treatment technology deals with the factors and mechanisms involved in the control of composition and properties of various materials with „getting it right" economically,. operationally, and environmentally

MODULE-I **(14 Hours)**

Principles of Heat treatment: Purpose of alloying, effect of alloying elements on ferrite, cementite, Fe-Fe3C system, tempering and TTT Curves, Austenitic Transformation, Pearlitic Transformation, Bainitic Transformation, Martensitic Transformation

MODULE-II **(14 Hours)**

Chemical and Thermo mechanical heat treatment: Annealing, Normalizing, Hardening, mechanism of heat removal during quenching, quenching media, size and mass effect, hardenability, tempering, austempering. Carburizing, cyaniding, flame and induction hardening, residual stresses, deep freezing, thermo mechanical treatments: HTMT, LTMT, Ausforming, Isoforming, Cryoforming.

MODULE-III **(14 Hours)**

Heat treatment of Ferrous alloys: Heat treatment of Plain carbon, Alloy and structural steels and Cast Iron Non-ferrous metals and alloys: Precipitation hardening, aging treatment, study of copper, aluminum, Mg and nickel and their alloysFurnaces: Heat treatment furnaces and their design, atmosphere control vacuum heat

treatment etc. Defects in Heat treatment and their remedies, Economics of heat treatment.

Text Books:

1. Heat Treatment Principle and Techniques by Rajan,Sharma
2. Principles of Heat treatment of steels by R C Sharma, New Age International, 2007
3. The steel Handbook by AlokNayar, McGraw-Hill Education, 2001

Reference Books

1. Handbook of Heat Treatment of steels by K H Prabhudev, Tata McGraw-Hill Publication.
2. Hand book on Heat Treatment of steels-Tata McGraw-Hill Education

Course Outcomes:

The student will have the ability to understand the advantages of heat treatment like increasing the strength of material improve machining, improving formability, restore ductility after a cold working operation. Thus it is a very enabling manufacturing process that can not only help other manufacturing process, but can also improve product performance by increasing strength or other desirable characteristics.

IMC202	Materials Characterisation Lab	0-0-4	Credits 2

Objectives of the course: To obtain hands on experience on characterization of various materials in the lab.To obtain knowledge on experimental tools and machinery required to conduct above experiments.

List of suggested experiments:

1. Physical examination and identification of minerals.
2. Crushing of ore/ coal in a jaw crusher and to study the size analysis of the product.
3. To study the jaw crusher and determine the actual capacity and reduction ratio.
4. Verification of Rittinger‟s Law of crushing in a jaw crusher.
5. Crushing of ore/ coal in a roll crusher and to study the size analysis of the product.
6. Crushing of ore/ coal in a gyratory crusher / pulveriser and to study the size analysis of the product.
7. Crushing of ore/ coal in a cone crusher and to study the size analysis of the product.
8. To study the effect of grinding with grinding time in cylindrical ball mill and rod mill.
9. To separate coal from a mixture of coal and stones or quarts by zigging and determine the weight fractions of the products.
10. To separate a mixture of two minerals of different densities by gravity concentration using Wilfley Table and determine the weight and density of each fraction of the products.

11. Beneficiation of ore pulp mix using flotation cell.
12. To separate a mixture of iron and sand using magnetic separator and determine its efficiency.
13. Screening of ore/ coal using vibrating screen and determine its effectiveness.
14. Proximate analysis of coal and coke.
15. To determine calorific value of coal and coke using bomb calorimeter.
16. To determine bulk density of coal sample.
17. To determine true density of coal sample.
18. To determine shatter and abrasion indices of coal and coke.
19. To determine flash point and fire point of a given sample such as kerosene oil, diesel, petrol by Pensky Marten's apparatus or Cleveland open cup apparatus.
20. To determine viscosity of oil by Engler viscometer and the water number in the apparatus.
21. To determine effect of temperature on kinematic viscosity of glycerene by Redwood viscometer.
22. Kinetic studies of oxidation of copper.
23. Kinetic studies of reduction of iron ores.
24. Kinetic studies of decomposition of calcium carbonate.
25. Kinetic studies of decomposition of magnesium carbonate.
26. To study the flow of gases through beds of solid particles.
27. Determination of heat transfer coefficient by using Newton‟s Law of cooling.
28. Leaching of sulphide ores.
29. Press moulding of polymers and polymer based composites.
30. Compaction of metal powders and determination of green density.
31. Sintering of metal powders and determination of sintered density.

Reference Books

1. Materials Characterization, Metals Handbook, Vol 10, ASM
2. Characterization of Materials, by E N Kaufman, Wiley Publishers
3. Structure of Metals, by Barett, C.S. and Massalski, T.B., Pergamon Press, Oxford.
4. Elements of X-ray Diffraction, by Cullity B.D., Addison-Wesley, 1978
5. Transmission Electron Microscopy by Williams, D.B. and Barry Carter C., Plenum Press

Course Outcomes: After completing this course, the student will be able to:

1. Perform laboratory experiments related to various characterization techniques.
2. Identify the tools and machinery involved in the various experiments related to material characterization.

IMC203	Advanced Materials Processing Lab	0-0-4	Credits 2

Objectives of the course: To obtain hands on experience in conducting processing experiments in lab such as casting, welding and forming. To obtain knowledge on experimental tools and machinery required to conduct above experiments.

List of suggested experiments:

1. To Synthesis of nano alumina (Al2O3) powders by Sol-Gel Processing.
2. To Synthesis of Titanium dioxide (TiO2) powders by Sol-Gel Processing.
3. To Synthesis of zirconia (ZrO2) powders by Sol-Gel Processing.
4. To synthesis of calcium titanate (CaTiO3) powders by Sol-Gel Processing
5. To synthesis of barium titanate (BaTiO3) powders by Sol-Gel Processing
6. To synthesis of calcium titanate (CaTiO3) powders using high energy ball mill.
7. To synthesis of calcium titanate (BaTiO3) powders using high energy ball mill.
8. To produce Fe2O3 powders using high energy ball mill.
9. To synthesis of hydroxyapatite (Ca10(PO4)6(OH)3) by solution precipitation
10. To produces Cu-Zn-NiO alloys using high energy ball mill
11. To produces Fe-C- Si metallic alloys using high energy ball mill
12. To produces Al-Si metallic alloys using high energy ball mill.
13. Press moulding of polymers and polymer based composites.
14. Compaction of metal powders and determination of green density.
15. Sintering of metal powders and determination of sintered density.
16. Solidification and melting of Al, Cu, Ni based alloys and to study their microstructure

Reference Books

1. Principles of Metal Casting by R. W. Haine, C. Loper, and P. C. Rosenthal. McGraw Hill Education, 2001
2. Introduction to Ceramics by Kingery, Bowen, Uhlman. Wiley India Pvt Limited, 2012

Course Outcomes:

1. Perform laboratory experiments related to different manufacturing processing, along with associated data analysis and interpretation of results
2. Identify the tools and machinery involved in the various experiments related to material processing.

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

M.TECH SYLLABUS for *Specialization*: INDUSTRIAL METALLURGY

BRANCH: METALLURGICAL AND MATERIALS ENGINEERING (2018-19 Admission Batch)

3rd semester

IME301	Pollution control and waste management in Iron and Steel Industries	3-0-0	Credits 3

Objectives of the course:

1. The course is designed to know the fundamental concepts and various technologies of industrial wastes and solid waste management helpful the students in brightening chances for getting wide range of employability both in industrial and community organizations.

MODULE-I **(14 Hours)**

Pollution Control in Ferrous: Introduction to need of environmental management. Policies, procedures and resources for implementing and maintaining effective environmental management in the organization. ISO 14000

MODULE-II **(14 Hours)**

Sources and classification of pollutants, Meterological factors influencing air pollution, Control of air pollution by equipments.Cleaner Production (Pollution Control) in Metallurgical Industries of Iron and Steel. Pollutant emissions from major fossil fuel consuming industries/sectors and their local and global effects.

Air pollution technology-I: Sampling and analysis of particulate matter and gaseous pollutants, removal of particulate matters, principles and design of settling chambers, solid traps, cyclone separators, fabric filters and fiber filters, scrubbers and electro-static precipitators

MODULE-III **(14 Hours)**

Solid, liquid and gaseous wastes generated from metallurgical industries: their recycling, reuse and management; waste heat recovery. Solid waste characteristics – generation rates, components, moisture content, density, proximate and ultimate analysis and energy content, solid waste collection & transportation – haul – container system, stationary container system, layout of collection routes, transfer stations, solid waste processing and recovery – recovery of materials for recycling, manufacturing of solid waste products, energy recovery, disposal of solid wastes – land filling methods, aspects of landfill implementation, sanitary landfill equipment.

Text/Reference Books:

1. Dust & Fume Generation in the Iron & Steel Industries, S.Andoneyev, O. Filipyev.
2. Air Pollution, M.N.Rao, HVN Rao
3. Environmental Engineering, G.N.Pandey.
4. Ray H.S. et al (ed), Energy and the Mineral and Metallurgical Industries, Allied Publishers.
5. Pandey G.N., A Textbook on Energy System Engineering, Vikas Publishing.
6. Rao C.S., Environmental Pollution Control Engineering, Wiley Eastern Ltd.

7. Nathanson J.A., Basic Environmental Technology, PHI.
8. Gupta R.C. (ed), Proc. Environmental Management in Metallurgical Industries, Allied Publishers.

Course Outcomes: At the end of the course, the student should be able to

1. Learn various theoretical and technical aspects of industries waste water treatment and solid waste management methods which are very significant in Iron and Steel sectors
2. Have design approach of Effluent Treatment Plants and solid waste recovery and recycling techniques and the students can brighten their chances of job opportunity in corporate companies engaged in design of pollution control equipments
3. Enhance their skills when they take up practical assignments in Sludge treatment
4. Pursue further research in the specific fields the interest of students
5. Enhance their knowledge with latest practices being adopted in the field of wastewater treatment and solid waste management.

IME302	Secondary Steel Making	3-0-0	Credits 3

Objectives of the course:

1. To study the concepts and various processing techniques involved in the field of secondary steel making.

MODULE-I **(14 Hours)**

Secondary steel making principles and practices: Objectives and techniques adopted in secondary steel making. Ladle metallurgy: Outline of inert gas stirring: CAS/CAS (OB), Ladle furnace, vacuum degassing of steel and related processes.

MODULE-II **(14 Hours)**

Transport phenomena in ladles: Role of slag and powders in inclusion control: Desulphurization, Dephosphorisation. Modification of inclusion morphologies, production of ultra low carbon, ultra low sulphur, ultra low phosphorus and inclusion free steels.

MODULE-III **(14 Hours)**

Tundish metallurgy: Evaluation of tundish hydrodynamic performances: Solidification phenomena: Conventional, continuous and near net shape casting phenomena. Powder injection systems. Production of alloy steel through post solidification treatments (VAR, ESR); Refractories used in secondary steel making furnaces, their properties and selection criteria. Process selection in secondary steel making.

Text/Reference Books:

1. Ghosh A., Secondary Steelmaking- principle & Applications, CRC Press.
2. Ghosh A., Principles of Secondary Steelmaking Processing and Casting of Liquid Steel, Oxford & IBH Publication.
3. Ghosh Ahindra, Chatterjee A., Ironmaking and Steelmaking Theory and Practices, PHI Pvt. Ltd..

Course Outcomes: At the end of the course, the student should be able to

1. Understand the basics of metallurgy involved in ladle metallurgy
2. Analyse the effects of process variables on quality of steel
3. Evaluate the tundish hydrodynamic performances

IME303	Surface Engineering	3-0-0	Credits 3

Objectives of the course:

1. To inculcate the basic aspects surface engineering, importance of surface energy and surface phenomena, knowledge on surface dependent engineering properties along with surface protection and modification.

MODULE-I **(14 Hours)**

Introduction: Concept of surface engineering, significance, methods of manufacturing and application of surface layers.

Solid surface: significance of the surface, geometrical, mechanical and physic-chemical concept of the surface, phase and interphase surface, surface energy and surface phenomena.

Surface dependent engineering properties, viz., wear, friction, corrosion, fatigue, reflectivity, emissivity, etc.; common surface initiated engineering failures; mechanism of surface degradation; importance and necessity of surface engineering; classification and scope of surface engineering in metals, ceramics, polymers and composites, tailoring of surfaces of advanced materials.

MODULE-II **(14 Hours)**

Surface protection (Physical); surface modification (Chemical) techniques: classification, principles, methods, and technology; conventional surface engineering methods: carburising, nitriding, cyaniding, diffusion coating, hot dipping, galvanizing etc.; electrochemistry and electro-deposition; scope and application of conventional surface engineering techniques in engineering materials; advantages and limitations of conventional processes.

MODULE-III **(14 Hours)**

Recent techniques of producing surface layers: formation of surface layers by mechanical, thermo-mechanical, thermal, thermo-chemical, electrochemical, physical techniques; electron beam technology; laser

echnology; ion implantation; glow discharge method and CVD technology; vacuum deposition by physical techniques (PVD).

Text/Reference Books:

1. Tadeusz Burakowski and Tadeusz Wierzchon, Surface engineering of metals - principles, equipments, technologies, CRC press.
2. Davis, J.R., Surface Engineering for Corrosion and Wear Resistance, Edited, ASM International

Course Outcomes: At the end of the course, the student should be able to

1. Acquire knowledge on basic principles tribology and other modes of surface degradation of materials
2. Enhance the knowledge of surface engineering in metals, ceramics, polymers and composites.
3. Analyse and select techniques of producing surface layer to protect the parent surface with respect to the application.
4. Analyse conventional surface engineering methods and acquire knowledge on advanced techniques.