Course Structure and Syllabus
of
B.Tech Programme
In

MECHANICAL ENGINEERING

(Admission Batch: 2018-19 Onwards)

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG
(An Autonomous Institute of Government of Odisha)
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INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

Course Structure for 4th Year B.Tech MECHANICAL ENGINEERING

(Admission Batch: 2018-19 Onwards)

Seventh Semester

Theory

Course Code	Course Name	L-T-P (Periods/ Week)	Credits
	Programme Core Subject		
PCME4411	Heat and Mass Transfer	3-0-0	3
PCME4412	Mechanical Handling Equipment	3-0-0	3
(Any One)	***Programme Elective III***	3-0-0	3
PEME5407/ PEME5408/ PEME5409	Mechatronic / Reverse Engineering and Rapid Prototyping / Refrigeration and Air conditioning		
(Any One)	***Programme Elective IV***	3-0-0	3
PEME5410/ PEME5411/ PEME5412	CAD, CAM & Robotics/ Machine Design - II/ Project Management		
(Any One)	***Open Elective IV*** Refer list of Open Electives	3-0-0	3
	Total (Theory)	**15**	**15**
	Honours/ Minor	3-1-0	4
HNME0410	Computational Fluid Dynamics		
HNME0411	Finite Element Method		
HNME0412	Automatic Control System		
MNME0405	Machine Dynamics and Design		

Practical/ Sessional

PJME8402	Minor Project	0-0-6	3
PJME8403	Seminar and Technical Paper Writing	0-0-3	2
Total (Practical/ Sessional)		**9**	**5**
TOTAL		**24**	**20**

TOTAL SEMESTER CREDITS: 20

TOTAL CUMULATIVE CREDITS: 145

Eighth Semester

(A) *For students who carry out Major Project in the Institute*

Theory

Course Code	Course Name	L-T-P (Periods/ Week)	Credits
(Any One)	***Programme Elective V***	3-0-0	3
PEME5413/ PEME5414/ PEME5415	Ergonomics and Human Factor Engineering/ Gas Dynamics/ Finite Element Method		
(Any One)	***Programme Elective VI***	3-0-0	3
PEME5416/ PEME5417/ PEME5418	Engineering Tribology/ Automobile Engineering/ Optimization in Engineering		
	Total (Theory)	**6**	**6**

Practical/ Sessional

PJME8405	Major Project	0-0-12	6
PJME8406	Comprehensive Viva Voce	0-0-3	1
PJME8404	Internship	0-0-3	2
	Total (Practical/ Sessional)	**18**	**9**
	TOTAL	**24**	**15**

OR

(B) *For students who carry out Internship based Major Project*

Practical/ Sessional

PJME8407	Internship based Major Project	---	12
PJME8406	Comprehensive Viva Voce	---	1
PJME8404	Internship	---	2
Total (Practical/ Sessional)		**---**	**15**
TOTAL			**15**

TOTAL SEMESTER CREDITS: 15

TOTAL CUMULATIVE CREDITS: 160

OPEN ELECTIVE SUBJECTS

OPEN ELECTIVE-IV (OE-IV) 7th Semester						
Sl. No.	**Subject Code**	**Subject Name**	**Contact Hours**	**Credits**	**Departments to Teach the Subject**	**Students to whom Option is Open**
1	OECH6432	Mineral Processing	3-0-0	3	Chemical Engg.	All branches
2	OECH6433	Colloid and Interfacial Engineering	3-0-0	3	Chemical Engg.	All branches
3	OECE6434	Finite Element Analysis	3-0-0	3	Civil Engg.	All branches
4	OECS6435	Research Methods in Computer Science	3-0-0	3	CSE	All branches
5	OEEE6323	Analog & Digital Communication Systems	3-0-0	3	Electrical Engg.	All branches
6	OEEE6436	Internet of Things	3-0-0	3	Electrical Engg.	All branches
7	OEEC6437	Soft Computing	3-0-0	3	ETC, CSE, Electrical Engg.	All branches
8	OEME6438	Reliability Engineering	3-0-0	3	Mech. Engg.	All branches
9	OEME6439	Robotics	3-0-0	3	Mech. Engg.	All branches
10	OEMT6440	Nanocomposites	3-0-0	3	MME	All branches
11	OEPD6441	Industrial Management	3-0-0	3	Prod. Engg.	All branches

CE:	Civil Engineering	CS, CSE:	Computer Science and Engineering
EE:	Electrical Engineering	EC, ETC:	Electronics and Telecommunication Engineering
ME:	Mechanical Engineering	MT, MME:	Metallurgical and Materials Engineering
CH:	Chemical Engineering	PD, Prod.:	Production Engineering
HM:	Humanities	MA:	Mathematics

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

B.TECH SYLLABUS for MECHANICAL ENGINEERING

(Admission Batch: 2018-19 Onwards)

7th Semester

PCME4411	Heat and Mass Transfer	3-0-0	Credit-3

Course Objective:

1. Understand different modes of heat transfer.
2. Analyze the effect of heat flow through different mediums.
3. Understand the real world application of convection through boiling and condensation.
4. Understand the radiation heat transfer and types of heat exchanger.

MODULE-I **(10 Hours)**

1. INTRODUCTION: Difference between heat transfer and Thermodynamics. Modes of heat transfer, Basic laws of heat transfer. Combined heat transfer mechanism, Analogy between flow of heat and electricity.

2. CONDUCTION : General Differential equation of Heat Conduction , Fourier Law of Conduction, Cartesian and Cylindrical Coordinates , Conduction One dimensional steady state heat conduction through slab, cylinder,
sphere, Composite system, Critical insulation thickness, effect of variable thermal conductivity Extended Surfaces,
Heat transfer through rectangular and pin fins, solutions of fin equation for different boundary conditions, Fin effectiveness, Fin efficiency Unsteady Heat Conduction , Lumped Analysis , Infinite and Semi Infinite Solids.

MODULE-II **(12 hours)**

CONVECTION : Basic Concepts ,Mechanism of convection, Convective Heat Transfer Coefficient, Boundary Layer Concept , Energy equation for the laminar boundary layer, Boundary layer similarities, Integral solution of boundary layer equation for laminar flow over a flat plate. Heat transfer for laminar flow in tubes, Mechanism of heat transfer in turbulent flow, Reynolds analogy, Natural convection over a vertical plate and Approximate solution, Dimensional analysis applied to free and forced convection, Correlation for external laminar flow, Correlation for external turbulent flow, Correlation for heat transfer to liquid metals, Correlation for free convection heat transfer.

MODULE-III **(08 hours)**

BOILING & CONDENSATION : Mechanism of film and drop wise condensation, Nusselt's theory of laminar film condensation, Pool boiling regimes, nucleate boiling, film boiling, Peak heat flux, Rohsenow correlation for Nucleate boiling.

MODULE-IV **(08 Hours)**

1. **RADIATION:** Basic concept of radiant heat transfer. Black body and monochromatic radiation, total emissive

power, Stephen Boltzmann law, grey body, Kirchhoff's law, Wien's displacement law, Relation between two blackbodies, Shape factors for simple geometries, radiation between two grey bodies, Electrical network method for solving radiation problems, radiation shield.

2. **HEAT EXCHANGER**: heat exchanger and its type, Overall heat transfer coefficient, Fouling factor LMTD, Effectiveness, NTU Methods for Heat exchanger design.

TEXT BOOK

1. Sachdeva, R.C., Fundamentals of Heat and Mass Transfer, Fourth Edition, New Age International (P) Ltd.,New Delhi, 2009
2. Nag, P.K., Heat Transfer, Tata McGraw Hill, New Delhi, 2011.
3. Holman, J.P., Heat and Mass Transfer, McGraw Hill, 2008.
4. Ozisik, M.N., Heat Transfer, McGraw Hill Book Co., 2003.
5. Yunus A. Cengel, Heat Transfer A Practical Approach – Tata McGraw Hill - Second Edition 2014
6. Frank P. Incropera and David P. Dewitt, Fundamentals of Heat and Mass Transfer, John Wiley & Sons, Seventh Edition, 2011.
7. Ghosh dastidar, P.S, Heat Transfer, Oxford, 2012

Upon successful completion of the course, student will be able to:

1. Differentiate between heat transfer and thermodynamics
2. Analyze heat flow through different mediums
3. Understand the boiling and condensation phenomenon
4. Design the heat exchanger

PCME4412	Mechanical Handling Equipment	3-0-0	Credit-3

Course objective:

This course is designed to give students a comprehensive understanding of the issues involved in the design of an industrial production system. It will cover the problems in plant location, product analysis, process design, equipment selection, materials handling, and plant layout. The objectives are:

1. To develop competency for system visualization and design.
2. To enable student to design cylinders and pressure vessels and to use IS code.
3. To enable student select materials and to design internal engine components.
4. To introduce student to optimum design and use optimization methods to design mechanical components.
5. To enable student to design machine tool gearbox.
6. To enable student to design material handling systems.
7. Ability to apply the statistical considerations in design and analyze the defects and failure modes in.

Module I (8 hours)

Overview of Material Handling; Principles of Material Handling, Principal groups of Material Handling

equipment – General Characteristics and application of Material Handling Equipment, Modern trends in material handling.

Module II (10 hours)

Lifting Equipment: Hoist Components of Hoist; Load Handling attachments hooks, grabs and clamps – Grabbing attachments for bulk material – Wire ropes and chains.

Module III (10 hours)

Lifting tackle pulleys for gain of force and speed; Tension in drop parts – Drums, Shears and sprockets – Arresting gear and brakes – Block brakes, Band brakes, thrust brakes – Safety and hand cranks. Principle operation of EOT, Gantry and jib cranes Hoisting Mechanisms, Travelling mechanisms, lifting mechanisms – Slewing Mechanisms – Elevators and lifts.

Module IV (8 hours)

Conveying Machines; Belt conveyors – Types, Principal components of a conveyor and their purpose – conveyor belts – tractive elements – take up devices Special types of belt conveyors – Metal Belt conveyor – Apron conveyor Elevators, Passenger conveyor – Flight conveyor, Principal types and application – Bucket flight conveyors – Cradle conveyor – conveyor elevators. Overhead conveyors – Overhead pusher conveyor, Overhead load towing truck conveyor – Load carrying car conveyors – Load towing and walking beam conveyors – Bucket elevators – Cradle conveyors – Screw conveyors – Oscillating conveyor – Roller conveyor Hydraulic and pneumatic conveyor – Chutes Bins. Current trends in Material Handling; Computer Aided Systems for Material Handling.

Text Books

1. Material Handling Equipments - N. Rudenko. Envee Publishers, ND, 1978.
2. Materials Handling Equipment – M.P. Alexandrov. Mie publications, Moscow
3. Conveying Machines (Vol I & II) - A.O.Spivakovsky, & V.K. Dyachkav. MIR Publication
4. Mechanical Engg Design - J.E.Shiegley. Mc-Graw Hill Book Co., 1986.
5. Design of Machine Elements - M.F. Spotts and T.E. Shoup. PHI, 1998.
6. Design of Machine Elements, V.B. Bhandari, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2nd Edition 2007.

Reference Books

1. Design of Machine Elements - V. Dobrovolsky, et al., MIR Publishers, 1977.
2. Machine Design - D.N. Reshetov. MIR Publishers, 1978.

DESIGN DATA HAND BOOKS:

1. Design Hand Book by S.M. Jalaluddin; Anuradha Agencies Publications Vidayal Karuppur, Tamil Nadu, Pin: 612605.
2. P.S.G. Design Data Hand Book, PSG College of Tech Coimbature
3. Design Data Hand Book, K. Lingaiah, McGraw Hill, 2nd Ed. 2003.

COURSE OUTCOME

On successful completion of the course students will be able to:

1. Demonstrate proficiency in supply chain operations, utilizing appropriate methods to plan and implement processes necessary for the purchase and conveyance of goods in a timely and cost-effective manner
2. It explains about the different types of material handling, advantages and disadvantages. It also suggests the selection procedure for the material handling along with its specifications.
3. Need for Material handling also explained with different techniques like Automated Material handling Design Program, Computerized material handling Planning will be dealt.
4. The Material handling is explained with models, selection procedure of material handling is depending on different function oriented systems. This also related with plant layout by which the minimization of the handling charges will come down.
5. The ergonomics related to material handling equipment about design and miscellaneous equipment.

PEME5407	Mechatronic	3-0-0	Credit-3

Course objective:

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 (09 hours)

Introduction: Definition of mechatronics, measurement system, control systems, microprocessor based controllers, mechatronics approach. 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 (09 hours)

Actuators: Actuation systems, pneumatic and hydraulic systems, process control valves, rotary actuators, mechanical actuation systems, electrical actuation systems. Signal Conditioning: Signal conditioning, filtering digital signal, multiplexers, data acquisition, digital signal processing, pulse modulation, data presentation systems.

Module III (16 hours)

Microprocessors and Microcontrollers: Microcomputer structure, microcontrollers, applications, programmable logic controllers. 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 **(06hours)**

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 Books

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.

PEME5408	Reverse Engineering and Rapid Prototyping	3-0-0	Credit-3

COURSE OBJECTIVES:

To expose the students to rapid prototyping processes, process optimization, software and programming in RP and reverse engineering process.

Module - 1

Product Development: Classification of manufacturing processes, Different manufacturing systems, Introduction to rapid Prototyping (RP), Need of RP in context to batch production, FMS and CIM and its application. Product prototyping – solid modeling and prototype representation, prototyping and manufacturing using CNC machining. Basic principles of RP steps in RP, Process chain in RP in integrated CAD-CAM environment, Advantages of RP

Module – 2

Rapid Manufacturing Process Optimization: factors influencing accuracy. Data preparation errors, Part building errors, Error in finishing, influence of build orientation.

Classification of different RP techniques based on raw materials, layering technique Process technology and comparative study of stereo lithography (SL), SL with liquid thermal polymerization, selective laser sintering, selective powder binding, Ballastic particle manufacturing –both 2D and 3D, Fused deposition modeling.

Module – 3

Laminated object manufacturing solid ground curing, Repetitive masking and deposition. Beam interference solidification, Holographic interference solidification special topic on RP using metallic alloys, Programming in RP modeling, Software for RP: STL files, Overview of Solid view, magics, imics, magic communicator.

Module -4

Introduction, Scope and tasks of RE - process of duplicating, Tools for Functionality- dimensional- developing technical data - digitizing techniques in RE, History of Reverse Engineering – Preserving and preparation for the four stage process – Evaluation and Verification- Technical Data Generation, Data Verification, Project Implementation, Data Management in RE, Data reverse engineering, Three data Reverse engineering strategies – Definition – organization data issues, Software application, Finding reusable software components , Design experiments to evaluate a Reverse Engineering tool – Rule based detection for reverse Engineering user interfaces

Text Book :

1. Rapid Prototyping and Engineering Applications, Frank W. Liou, CRC Press
2. Introduction to Rapid Prototyping, Amitav Ghosh, North West Publication, New Delhi
3. Reverse Engineering, Katheryn, A. Ingle, McGraw-Hill, 1994

Reference Books :

1. Rapid Manufacturing, Flham D.T &Dinjoy S.S Verlog London 2001.
2. Stereo Lithography and other RP & M Technologies**,** Paul F. Jacobs: SME, NY 1996.
3. Data Reverse Engineering, Aiken, Peter, McGraw-Hill, 1996
4. Reverse Engineering, Linda Wills, Kluiver Academic Publishers, 1996

COURSE OUTCOMES

1. Apply the basics of rapid manufacturing techniques in manufacturing
2. Apply the liquid and solid and powder based rapid prototyping system in suitable applications
3. Apply the different programming parts for rapid prototyping system
4. Apply the concepts of reverse engineering in rapid prototyping and new technologies

PEME5409	Refrigeration and Air conditioning	3-0-0	Credit-3

Course Objective:

1. Understand the concept of refrigeration process and its application
2. Understand different refrigeration cycle operations and types of refrigerants
3. Understand the effect of moisture content on human comfort
4. Understand the air conditioning system.

MODULE-I **(10 HRS.)**

1. **Air Refrigeration System**: Introduction, Unit of refrigeration, Coefficient of performance, Reversed Carnot Cycle, Temperature limitations, maximum COP, Bell Coleman air cycle.
2. **Vapour Compression System**: Analysis of theoretical vapour compression cycle, Representation of cycle on T - S and p - h diagram, Simple saturation cycle, sub-cooled cycle and super-heated cycle, Effect of suction and discharge pressure on performance, Actual vapour compression cycle. Multi-stage compression and Multi-evaporator systems with Different arrangements of compressors and inter-cooling Dual compression system.

MODULE-II (12 HRS.)

1. **Vapour Absorption System**: Simple Ammonia - absorption system, Improved absorption system, Electrolux / Three fluid system, Lithium-bromide-water vapour absorption system, comparison of absorption system with vapour compression system.
2. **Refrigerants :** Classification of refrigerants and its nomenclature, Properties of refrigerants, comparison of common refrigerants, uses of important refrigerants, Alternative refrigerants

MODULE-III (08 HRS.)

1. **Psychrometrics:** Properties of air-vapour mixture, Law of water vapour-air mixture, Enthalpy of moisture, Psychrometric chart, simple heating and cooling, Humidification, Dehumidification, Mixture of air streams.

2. **Requirements of comfort air conditioning**: Oxygen supply, Heat removal, moisture removal, air motion, purity of air, Thermodynamics of human body, comfort and comfort chart, effective temperature, factors governing optimum effective temperature.

MODULE-IV (08 HRS)

Air Conditioning System: Process in air conditioning: Summer air conditioning, Winter air conditioning and year round air conditioning, Cooling load calculations.

TEXT BOOK

1. Refrigeration and Air conditioning by C.P. Arora, Tata McGraw Hill.
2. A course in Refrigeration and Air conditioning, Arora S. C. and Domkundwar S., Dhanpat Rai (P) Ltd., New Delhi
3. Refrigeration and Air conditioning, Manohar Prasad, New Age International (P) Ltd, New Delhi

Upon successful completion of the course, student will be able to:

1. Understand the necessity of refrigeration
2. Determine the application of specific refrigerants on different refrigeration system
3. Understand the use of psychrometry and human comfort zone
4. Understand different air-conditioning system

PEME5410	CAD, CAM & Robotics	3-0-0	Credit-3

Course Objectives: To introduce new field of CAD/CAM, concepts associated with Robotics and Automation. To understand mathematical representation of curve and surfaces. To model the object using Wireframe, surface and solid modeling techniques To design a basic automation system and its applications To understand techniques of Rapid prototyping and their applications. To study kinematics and dynamics to understand exact working pattern of robots

Unit 1 Fundamentals of CAD/CAM: Product cycle on CAD/CAM product features of CAD/CAM software. Geometric transformation. 2Dand3D Transformation, Translation, Rotation, Scaling, Reflection, Homogenous transformation, geometric concatenation, orthographic projection, mapping, perspective transformation. Orthographic transformation, Oblique Projections. Mathematics Representation of Curves and Surfaces: Design of curves, parametric space of curves Blending function. Analytic curves, line circle parabola ellipse, hyperbola Synthetic curves, Introduction to Bezier surface spine surface, B-Spline surface.

Unit 2 Solid Modeling: Solid Modeling fundamentals, topology and geometry, Requirements of Geometric Modeling generalize concept of boundary set theory, Euler's operator. Geometric Modeling Method, Constructive Solid Geometry (CSG), Boundary Representation (Brep), Introduction to Wireframe, surface and solid modeling techniques. Introduction CAD data exchange format IGES, STEP

Unit 3 NC and CNC Technology: Introduction to automation. Need and future of NC, CNC and CAM. Basic component of NC, application and classification. Merit and demerit of NC and CNC. Dimensioning, axes designation, NC motion control. Introduction to Part programming, Introduction to group technology.

Unit 4 Automation and robotics –History of robotics, Robot anatomy ,Robot configurations, Robot Components, Types of Robot drives – pneumatic, hydraulic and electrical drive systems, Transformations and Kinematics: Coordinate transformation -Vector operations – Basic transformations matrices - Inverse kinematic solution, Brief Robot dynamics

Unit 5 Controls and End Effectors: Control system concepts - Analysis - control of joints - Force analysis and Gripper design. Robot Applications: Work cell control and interlocks, Robot applications in manufacturing like material transfer and machine loading/unloading, processing operations, assembly and inspection, etc. Introduction to Robotics Technology of the future, Future applications. Automation; Introduction , Types of Automation, Types of Automation Systems, Programmable Logic Controllers, Parts of a typical PLC system, Programming of PLC, Example applications of PLC in a CNC machine.

Text and Reference Books

1. Faux, Prat, "computational geometry for design and manufacture"- Ellis Horwood.
2. Rogers and Adams, "Mathematical elements for computer graphics" Mcgraw Hill publications, New York
2. Rogers and Adams, "Procedural elements for computer graphics" Mcgraw Hill publications, New york
3. Mortenson M.E., "Geometric Modeling", John wiley and sons, New york, 1985

4. Hearn, Paulin, "Computer Graphics".-Pearson.
5. Martti Mantylla, "An introduction to solid modeling", computer science press. 8. Ibrahim, CADCAM - Tata McGraw hill.
6. Groover M.P. Weiss Mithell Nagel R.N., Odery N.G., "Industrial Robotics, Technology, Programming and Applications", McGraw Hill International Editions, 1986.
7. Klafter,"Robotics Engineering", PHI Pvt. Ltd., New Delhi.
8. Ks. Fu, Rc. Gonzalez, CSG Lee, "Robotics", McGraw Hill International Editions.
9. Grover M.P., "Automation Production Systems, and Computer Integrated Manufacturing", Second Edition, Pearson Education, India, 2006.
10. Groover M.P., Zimmers E.W., "CAD/CAM Computer Aided Design and Manufacturing", PHI, Pvt. Ltd., New Delhi, 2002.
11. Radhakrishnan P. Subramanian S., Raju V.,"CAD/CAM/CIM", New Age International Publishers Pvt. Ltd., New Delhi, India, 2008.

Course Outcome:

After completing the course, students will be able to:

1. Identify proper computer graphics techniques for geometric modelling.
2. Acquire fundamental knowledge of CAD/CAM.
3. Understand modelling of curves, surfaces and solids.
4. Generate tool path for part and to create CNC manual part program and APT part program.
5. Understand robotics and automation terminology
6. Evaluate and plan robotic path.
7. Understand industrial environment for robotics system

PEME5411	Machine Design - II	3-0-0	Credit-3

Course objective: Machine design is the art of planning or devising new or improved machines to accomplish specific purposes. Idea of design is helpful in visualizing, specifying and selection of parts and components which constitute a machine.

1. To learn about bending and torsional stresses in machine parts.
2. To learn Theories of Failure.
3. To learn Review of axial in machine parts
4. To understand Cone clutch and Centrifugal clutch.
5. To familiar with Friction clutch.
6. To familiar with sliding contact bearings.

Module I (10 hours)

1. Theories of Failure, Application of Practical problems.

2. Variables stresses (Fatigue), Endurance limit, o - N curve, Fatigue stress concentration factor, Goodman and Soderberg criteria, Application to Practical problems.
3. Design of Pressure vessels: Thin cylindrical shell, thick cylindrical shell, thin spherical shell, Illustrative problems with solution.

Module II (8 hours)

1. Design of clutch (Friction & Centrifugal type)
2. Design of Brake: Block & Band brake, Internal expanding shoe brake.
3. Design of sliding contact bearings, Journal bearing, foot step bearing, Illustrative problems with solutions.

Module III (8 hours)

1. Types and selection of ball and roller bearings, Dynamic and static load ratings, Bearing life, Problem illustration.
2. Design of straight and Helical spur gears, bevel gears. Illustrative problems with solutions.

Module IV (10hours)

Design of Engine components: Piston, Connecting Rod, Crank Shaft, Flywheel, Illustrative problems with solutions.

TEXT BOOKS:

1. Mechanical Engineering Design, J.E.Shigley, C.R.Mischke, R.G.Budynas and K.J.Nisbett, TMH
2. Design of Machine Elements, V.B. Bhandari, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2nd Edition 2007.
3. A Text Book of Machine Design, R.S.Khurmi and J.K.Gupta, S.Chand Publication

REFERENCE BOOKS:

1. Machine Design, Pandya and Shah, Charotar Book Stall
2. Machine Design, Robert L. Norton, Pearson Education Asia, 2001.
3. Machine Design, A CAD Approach: Andrew D Dimarogonas, John Wiley Sons, Inc, 2001.
4. Fundamentals of Machine Component Design, Robert C. Juvinall and Kurt M Marshek, Wiley India Pvt. Ltd., New Delhi, 3rd Edition, 2007
5. Machine Design, H.Timothy and P.E.Wentzell, Cengage Learning
6. Computer Aided Analysis and Design, S.P.Regalla, I.K.International Publishing

DESIGN DATA HAND BOOKS:

1. Design Hand Book by S.M.Jalaluddin; Anuradha Agencies Publications Vidayal Karuppur, Tamil Nadu, Pin: 612605.
2. P.S.G. Design Data Hand Book, PSG College of Tech Coimbature
3. Design Data Hand Book, K. Lingaiah, McGraw Hill, 2nd Ed. 2003.

COURSE OUTCOME

On successful completion of the course students will be able to:

1. Select appropriate gears for power transmission on the basis of given load and speed
2. Design gears based on the given conditions.

3. Select bearings for a given applications from the manufacturers catalogue.
4. Select and/or design belts and flywheel for given applications
5. Design clutches and brakes
6. Graduate will learn Gerber and Soderberg criteria.
7. Graduate will be familiar with Fatigue stress concentration factor.
8. Graduate will learn Thin cylindrical and spherical shells.
9. Graduate will learn about Internal expanding shoe brake.
10. Students will be able to understand selection of ball and roller bearings.
11. Select bearings for a given applications from the manufacturers catalogue.
12. Students will learn Piston, Connecting Rod, Crank Shaft, Flywheel

PEME5412	Project Management	3-0-0	Credit-3

Module-I

Project Management Concepts and Needs Identification Attributes of a Project, Project Life Cycle, The Project management Process, Benefits of Project Management, Needs Identification, Project Selection, Project organization, the project as part of the functional organization. Project feasibility Analysis: Technical feasibility, commercial and financial visibility, Environment Analysis.

Module-II

Project Planning and Scheduling: Design of project management system; project work system; work breakdown structure, project execution plan, work packaging plan, project procedure manual; project scheduling; bar charts, line of balance (LOB) and Network Techniques (PERT / CPM)/ GERT, Resource allocation, Crashing and Resource Sharing, capacity planning and expansion capacity decision.

Module III

Project Monitoring and Control and Project Performance Planning, Monitoring and Control; Design of monitoring system; Computerized PMIS (Project Management Information System). Coordination; Procedures, Meetings, Control; Scope/Progress control, Performance control, Schedule control, Cost control, Performance Indicators; Project Audit; Project Audit Life Cycle, Responsibilities of Evaluator/ Auditor, Responsibilities of the Project Manager.

Books:

1. Project Planning, Analysis, Selection, Financing, Prasana Chandra, TMH
2. Project Management, Grey, TMH.
3. Project Management, Richman, PHI
4. Project Management, Vasant Desai, HPH
5. Project Management, Bhavesh M.Patel, Vikash
6. Project Engineering & Management- Prasanna Chandra, Prentice Hall.

HONOURS

HNME0410	Computational Fluid Dynamics	3-1-0	Credit-4

Course Objective:

1. Ability to know the basic difference between finite difference method, finite element method and finite volume method.
2. Ability to solve the tri-diagonal matrix.
3. Ability to discretised the physical domain in to the control volume.
4. Ability to solve the diffusion problem, convection diffusion problem and unsteady state problem.
5. Ability to solve the physical problem by computational method

MODULE-I (10 HRS.)

1. Basics of Computational Fluid Dynamics (CFD) - Introduction to One dimensional computation: Finite difference methods (FDM)-Finite element method (FEM)-Finite volume method (FVM). Solution of Discretised Equations:
2. The tri-diagonal matrix algorithm (Thomas Algorithm for one dimensional case) The Finite Volume Method for Diffusion Problems-Introduction -Finite volume method for one dimensional steady state diffusion -Worked examples: one-dimensional steady state diffusion

MODULE-II (12 HRS.)

1. The Finite Volume Method for Convection-Diffusion Problems – Introduction - Steady one dimensional convection and diffusion
2. The central differencing scheme - Assessment of the central differencing scheme for convection-diffusion problems - The upwind differencing scheme - Assessment of the upwind differencing scheme - The hybrid differencing scheme - Assessment of the hybrid differencing scheme - The power-law scheme - Higher order differencing schemes for convection-diffusion problems - Quadratic upwind differencing scheme: the QUICK scheme .

MODULE-III (08 HRS.)

1. The Finite Volume Method for Unsteady Flows - Introduction - One-dimensional unsteady heat conduction - Explicit scheme - Crank-Nicolson scheme - The fully implicit scheme - Illustrative examples

MODULE-IV (08 HRS)

1. Implicit method for two- and three-dimensional problems - Discretisation of transient convection-diffusion equation - Worked example of transient convection-diffusion using QUICK differencing.

TEXT BOOK

1. Versteeg, H. K. , Malalasekera W , An Introduction to Computational Fluid DynamicsThe Finite Volume Method, Longman Scientific & Technical.
2. Patenkar V. Subas, Numerical Heat Transfer & Fluid Flow, Taylor & Francis
3. Muralidhar, K. and Sundararajan, T., Computational Fluid Flow and Heat Transfer, Norosa Publishing House, N. Delhi.

REFERENCE BOOKS

1. Ozisik, M. N., Finite Difference Method, CRC Press.
2. Anderson, D. A. Jr, Computational Fluid Mechanics and Heat Transfer, McGraw-Hill

Upon successful completion of the course, student will have:

1. Ability to discretised the physical domain
2. Ability to solve the physical problem via control volume method

HONOURS

HNME0411	Finite Element Method	3-1-0	Credit-4

Course Objective:

1. Understand the fundamental concepts of FEM.
2. Understanding the use and knowledge of Galerkin Method.
3. Know the behavior and usage of each type of elements covered in this course.
4. Be able to prepare a suitable FEM model for structural mechanical analysis problems.
5. Understanding vibration related problems.

MODULE – I **(12 HOURS)**

Review of 2-D and 3-D stress analyses, vibration, fluid flow and heat conduction problems. FEM fundamental concepts, Variational principles, Rayleigh Ritz and Galerkin Methods. Finite Element Modeling of one dimensional problems. Finite Element Analysis of 2-D and 3-D framed structures.

MODULE – II **(12 HOURS)**

FEM formulation of 2-D and 3-D stress analysis problems. Axisymmetric solids subjected to axisymmetric loadings. Two-dimensional isoparametric elements and numerical integration.

MODULE – III **(12 HOURS)**

FE modeling of basic vibration problems Finite element modeling of fluid flow and heat conduction problems Computer programs: preprocessing and post processing. Exposure to commercial FE codes such as ANSYS, NASTRAN and IDEAS etc.

TEXT BOOKS

1. Finite Elements in Engineering, T.R. Chandraputla and A.D. Belegundu, PHI
2. The Finite Element Method – Its Basis & Fundamentals, Zienkiewicz, Taylor and Zhu, Elsevier, 6th

Edn

REFERENCES

1. Introduction to Finite Element Method, C.Desai and J.F.Abel, CBS publishers
2. Introduction to Finite Element Method, J.N.Reddy, Tata McGraw Hill
3. Numerical Methods in Finite Element Analysis, K.J.Bathe and E.L.Wilson, PHI
4. Concepts & Applications of Finite Element Analysis,Cook, D.S.Malkus & M.E.Plesha, Wiley
5. The Finite Element Method in Engineering, S.S.Rao, Elsevier
6. A First Course in the Finite Element Method, D.L.Logan, Cengage Learning
7. Fundamentals of Finite Element Analysis, David V. Hutton, Tata McGraw Hill

Course Outcome

On successful completion of the course students will be able to:

1. Apply knowledge of finite element method for understanding, formulating and solving engineering problems.
2. Acquire knowledge and hands-on competence in applying the concepts finite element method in the analysis of structural and thermal systems.
3. Demonstrate creativeness in designing new systems components and processes in the field of engineering.
4. Identify analysis and solve mechanical engineering problems useful to the society.
5. Work effectively with engineering and science teams as well as with multidisciplinary problems.

HONOURS

HNME0412	Automatic Control System	3-1-0	Credit-4

Course objective:

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 **(08 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 **(10 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 **(10 hours)**

Root locus method; Nyquist criterion; Closed loop frequency response; M-circle & N-circle; Lag & lead compensation.

Module IV **(12 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 Books

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 OUTCOME

1. Represent the mathematical model of a system.
2. Determine the response of different order systems for various step inputs.
3. Analyse the stability of the system.

MINOR

MNME0405	Machine Dynamics and Design	3-1-0	Credit-4

[Only specified design data book as mentioned in the syllabus is permitted during examination]

Course Objective:

1. To study the mechanism and linkage system.
2. To Study theory of gears and gear trains.
3. To understand the concept of brakes and belt drives.
4. Understand the fundamentals of machine designs.

Module – I **(10 Lectures)**

1. Kinematic fundamental: Basic Kinematic concepts and definitions, Degrees of freedom, Elementary Mechanism: Link, joint, Kinematic Pair, Classification of kinematic pairs, Kinematic chain and mechanism, Gruebler's criterion, Inversion of mechanism, Inversions of Four bar linkage, Single slider crank mechanism and Double slider crank mechanism.
2. Mechanism Trains: Gear Terminology and definitions, fundamental law of gearing, Spur, bevel, helical, worm gears. Analysis of mechanism Trains: Simple Train, Compound train, Reverted train, Epicyclic train and their applications.

Module – II **(10 Lectures)**

3. Friction Effects: Friction between pivot and collars, single, multi-plate and cone clutches, friction circle, friction axis. Classification of brakes, Analysis of internal expanding shoe brake, Absorption

and transmission dynamometers, Rope brake dynamometer, Belt transmission dynamometer, Belt drives, Initial tension, Effect of centrifugal tension on power transmission, Maximum power transmission capacity, Belt creep and slip.

4. Mechanism for Control: Turning moment diagram, Turning moment diagrams for different types of engines, Fluctuation of energy and fluctuation of speed, Dynamic Theory of Flywheel. Governors - Watt, Porter, Proell, Hartnell, Wilson-Hartnell Governor, Performance parameters: Sensitiveness, Stability, Hunting, Isochronism. Introduction to Gyroscopes, Gyroscopic forces and Couple.

Module – III (6 Lectures)

5. Mechanical Engineering Design: Introduction to design procedure, Stages in design, Code and Standardization, Interchangeability, Preferred numbers, Fits and Tolerances, Design requirements – properties of materials, Material selection, Use of Data books.
6. Fundamentals of Machine Design: Types of load, Modes of failure, factor of safety concepts, concept and mitigation of stress concentration, Fatigue failure and curve, endurance limit and factors affecting it, Notch sensitivity.

Module – IV (10 Lectures)

7. Machine Element Design: Design of Joints: Rivets and welds based on different types of loading, Boiler joints, Socket and Spigot cotter joint and knuckle joint.
8. Design of Keys, Shaft and Couplings: Classification of keys, Design of keys, Theories of failure, Design of shafts: based on strength, torsional rigidity and fluctuating load, ASME code for shaft design, Design of couplings: Rigid coupling, Flexible coupling.

Text Books

1. Kinematics and Dynamics of Machinery by R L Norton, Tata McGraw Hill
2. Theory of Machines and Mechanisms by John J. Uicker Jr., Gordon R. Pennock and Joseph E. Shigley, Oxford University Press.
3. Theory of Machines by S.S. Rattan, Tata McGraw Hill
4. Design of Machine Elements, V.B. Bhandari, Tata McGraw Hill
5. Mechanical Engineering Design, J.E.Shigley, C.R.Mischke, R.G.Budynas and K.J.Nisbett,TMH

Reference Books

1. Theory of Machines by Thomas Bevan, CBS Publications
2. Mechanism and Machine Theory by J.S. Rao and R.V. Dukipatti, New Age International.
3. Theory of Mechanisms and Machines by A. Ghosh& A. K. Mallick, East West Press.
4. Machine Design, P.C. Sharma and D.K. Agrawal, S.K. Kataria& Sons
5. Machine Design, Robert L. Norton, Pearson Education Asia.
6. Design of Machine Elements by C. S. Sharma and K. Purohit, PHI

DESIGN DATA HAND BOOKS:

1. P.S.G. Design Data Hand Book, PSG College of Tech Coimbatore
2. Design Data Hand Book, K. Lingaiah, McGraw Hill, 2nd Ed. 2003.
3. Design Hand Book by S.M. Jalaluddin ; Anuradha Agencies Publications
4. Design Data Hand Book by K. Mahadevan and B.Reddy, CBS Publisher.

Course Outcome

On successful completion of the course students will be able to:

1. Understand the basic concept of Kinematics and mechanism.
2. Understand the basic concept of Gear, types of gears and Gear Trains.
3. Understand the basics of governors.
4. Understand the concepts of joints.
5. Understand the design of keys and failure theories.

OPEN ELECTIVE-IV (OE-IV) 7th Semester

OECH6432	Mineral Processing	3L-0T-0P	3 Credits

Objectives of the Course:

1. This course will brief about how most of the ores undergo after mining in order to provide a more concentrated material for the procedures of extractive metallurgy.
2. It gives the preliminary idea about the primary operations such as comminution and concentration.
3. This course will also provide the information about a modern mineral processing plant, including sizing, sampling and bulk material handling.

Module-I: **(4 weeks/12 Hours)**

Unit I: Comminution: Fundamentals of Rock Breakage, Energy Estimations, Liberation, Reduction Ratio, Primary Crushers, Secondary Crushers, Circuits, Selection Criterion. Grinding Mills, Critical Speed, Recent Developments & Mass Balancing (Importance, Techniques, Numerical Examples and their Relevance

Unit II: Industrial Screening: Applications, Basic Design Features, Types of Screens, Performance Evaluation and Factors Affecting Performance. Movement of Solids in Fluids: Equation of Motion, Drag Curve, Free & Hindered Terminal Settling Velocities in Gravitational and Centrifugal Force Fields, Applications & Classifiers (Various Types and Their Applications).

Module-II: **(4 weeks/12 Hours)**

Unit III: Hydrocyclone: Principles of Operation, Design Variables, Operating Variables, Performance Evaluation of Hydrocyclone, Control of Cyclone Operation, Recent Developments.

Unit IV: Gravity Concentration: Fundamentals, Flowing Film Type, Static Bath Type, Jigging, Centrifugal & Enhanced Gravity Type Concentrators.

Module-III: **(4 weeks/12 Hours)**

Unit V: Flotation: Fundamentals, Role of Reagents, Flotation Machines, and Applications.

Unit VI: Bulk Material Storage and Handling: Properties of Bulk Solids, Measurements, Storage, Flow Modes, Silos, Bins and Hopper Design, Common Problems.

Module-IV: **(2 weeks/6 Hours)**

Unit VII: Slurry Transportation: Pipe Line Flow, Mixture properties, Design perspective, Influence of several factors, Basic calculations, Case studies.

Books for Reference:

1. Mineral Processing Technology by B.A.Wills and Tim Napier-Munn.
2. Principal of Mineral Dressing by A.M. Gaudin – McGraw Hill Company, 1971.
3. Jain, S.K., Ore Processing, Oxford – IBH Publishing, 1984.
4. Taggart, A.F., Handbook of Mineral Dressing, John Wiley and Sons, New York, 1990.
5. Wills, B.A. Mineral Processing Technology, Pergamon Press, 1985.
6. Vijayendra, H.G., Handbook on Mineral Dressing, Vikas Publishing House Pvt. Ltd. 1995.

Course Outcomes:

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

1. Solve problem related to changes in size and shape of the mineral.
2. Understand briefly about the operation of a mineral plant
3. Can handle problem related to material transportation, material handling and storage.

OECH6433	Colloid and Interfacial Engineering	3L-0T-0P	3 Credits

Objective of the course: To provide comprehensive knowledge on concepts and principles of colloids, interfaces and their applications.

Module-I (12 Hours/4 Weeks)

Unit – 1 (6 Hours/2 Weeks) General introduction of colloids, interfaces, surfactants, and micellization. Intermolecular forces, van der Waals' forces (Keesom, Debye, and London interactions).

Unit – 2 (6 Hours/2 Weeks) Colloidal systems and colloidal stability (van der Waals' attraction and potential energy curves). Brownian motion and Brownian flocculation.

Module-II (12 Hours/4 Weeks)

Unit – 3 (6 Hours/2 Weeks) Surface and interfacial tension and surface free energy. Surface tension for curved interfaces.

Unit – 4 (6 Hours/2 Weeks) Surface excess and Gibbs equation. Theory of surface tension, contact angle, and wetting.

Module-III (12 Hours/4 Weeks)

Unit – 5 (6 Hours/2 Weeks) Thermodynamics of interfaces, thermodynamics of micelle and mixed micellar formation.

Unit – 6 (6 Hours/2 Weeks) Electrical phenomena at interfaces (Electro kinetic phenomena, Electrical double layer). Emulsion and micro emulsion, General applications.

Module-IV (6 Hours/2 Weeks)

Unit –7 (6 Hours/2 Weeks) Enhanced petroleum recovery, super hydrophobic and self-cleaning surfaces. Novel fabrication of nano-structured particles. Measurement techniques of surface tension, Contact angle, Zeta potential, Particle size.

Text Books

1. Principles of Colloid and Surface Chemistry, 3rd ed. by P CHiemenz and R Rajagopalan, Mercel Dekker.
2. Introduction to Colloid & Surface Chemistry, 4th ed. by D J Shaw, Butterworth Heinemann.
3. Colloid and Surface Chemistry by P. Somasundaran, Create Space Independent Publishing Platform.
4. Introduction to Applied Colloid and Surface Chemistry by G. M. Kontogeorgis and S. Kiil, John Wiley & Sons.

Course Outcomes:

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

1. Understand the colloidal science engineering fundamentals.
2. Characterize interfaces and surface phenomena.

OECE6434	Finite Element Analysis	(3-0-0)	Credit-03

Module I:

Introduction: The Continuum, Equations of Equilibrium, Boundary Conditions, Strain displacement relations, Stress strain Relations, Plane stress and plane Strain problems, Different methods of structural analysis including numerical methods. Basics of finite element method (FEM), different steps involved in FEM, Different approaches of FEM, Direct 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, application of displacement boundary conditions, Numerical solution of one dimensional problems using bar, truss, beam elements and frames. Derivation of shape function using Lagrange's interpolation, Pascal's triangle, Convergence criteria.

Module III:

Finite Element modeling of two dimensional problems using Constant strain Triangle (CST) elements, Stress strain relations for isotropic and orthotropic materials, Four nodded rectangular elements, axisymmetric solids subjected to axisymmetric loading.

Isoparametric Elements: Natural coordinates, isoparametric elements, four node, eight node elements. Numerical integration, order of integration.

Module IV:

Plate Bending: Bending of plates, rectangular elements, triangular elements and quadrilateral elements, Concept of 3D modeling.

Text Books:

1. C. S. Krishnamoorthy, Finite Element analysis-Theory and Programming, TMH
2. Finite Element Method, R. Dhanraj and K. P. Nair, Oxford University Press
3. Finite Element Methods for Engineers by U.S. Dixit, Cengage Learning

Reference Books:

1. R. D. Cook., Concepts and Applications of Finite Element Analysis, Wiley.
2. M. Mukhopadhyay-Matrix and Finite Element Analysis of Structures
3. O. C Zienkiewicz .and R. L. Taylor, Finite Element Method, McGraw Hill
4. Introduction to Finite Elements in Engineering, T.P. Chandrupatla and A.D. Belegundu

5. Finite Element Analysis in Engineering Design, S. Rajasekharan.

OECS6435	Research Methods in Computer Science	(3-0-0)	Credit-03

Prerequisites:

The course does not have any formal prerequisites. You must have a research project in sufficient maturity so you can finish a meaningful portion of your research and a complete paper by the end of the semester. The research topic can be a portion of your BTech, MCA, MS, MTech or PhD thesis project, a significant extension of course projects from the past, or something you are passionate about. This course is most appropriate for graduate students who are interested in research but do not have extensive prior research experience.

Course Objectives:

1. To introduce research and research methodologies in CS to students going to peruse research in CS.
2. To understand the strengths and weakness of each of these methods.
3. How to choose suitable method(s) for the investigations?
4. How to carry out investigations using these methods?
5. What are the threats associated with these methods and how to deal with them.
6. Reporting the results of these investigations. Writing technical articles/research papers.
7. Understanding roles of authors, reviewers. How to review research articles?

Module I: **10 Hrs.**

Introduction to Research, Research Methods in Computer Science, Analytical vs. Empirical Methods, Surveys, Case Studies, Controlled Experiments, Ethnography and Action Research, Quantitative, Qualitative, and Mixed Methods, Choosing research methods, Validity threats, Meaning of Research Problem, Data collection methods - primary and secondary sources, Types of data analysis methods, Analysis and Interpretation of Quantitative Data, Descriptive Statistics, Sampling, sampling distribution, Parameter Estimation, Statistical Inference, confidence interval and Hypothesis Testing using normal distribution, Tests of significance, test of difference of mean and proportions, t-tests, ANOVA, Chi-square Tests, correlation and regression, Review Process, Review guidelines, Validity threats, Review decisions, Research Qualitative Methods, Study Designs, Elements, and Methods, The nature and types of qualitative research, Study Designs, Elements, and Methods, The nature and types of qualitative research, problem definition, Sources of research problem, Scope and objectives of research problem, Criteria characteristics of a good research problem, Errors in selecting a research problem, Approaches of solutions for research problem, Necessary Instrumentation, use of SPSS package.

Module II: **10 Hrs.**

Survey Research, Sampling Methods, Survey Study Designs, Case Studies, Introduction to Mixed Methods Research, Study Designs and Method, An Empirical Research Framework, Research Problems, Literature Reviews, Study Designs, Controlled Experiments, Elements and Methods Example Experiments Effective literature studies approach, Analysis, Plagiarism, Research Ethics, Effective technical writing, How to write report, paper, Developing a research proposal, Format of research Proposal, A presentation and assessment by a review committee, IEEE guidelines for writing abstract, journal papers, power point presentation, thesis and project report, Writing research papers, purpose, nature and evaluation, content and format, Research

Presentations, The Art of Scientific and Technical Writing.

Module III: **10 Hrs.**

Nature of Intellectual property, Patents, Design, Trade and copy right, Process of patenting and development, Technological research, innovation, patenting, development, International scenarios: International cooperation on intellectual property, Procedure for grants of patents, Patenting under PCT, use of **Turnitin** service.

Module IV: **10 Hrs.**

Patent rights: Scope of patent rights, Licensing and transfer of technology, Patent information and databases, Geographical Administrations, New Developments in IPR, Administration of patent system, New Development in IPR: IPR of biological system, software etc., Traditional knowledge case studies, IPR and IITs, case studies

Text Book:

There is no text book for the course. A teacher may use lecture notes and videos, read research papers and Web Pages, which will be freely available on internet websites.

Reference books:

1. Research Design. Qualitative, Quantitative, and Mixed Methods Approaches. By John W. Creswell, Fourth Edition. SAGE Publication, 2014
2. The Craft of Research, By Wayne C. Booth, Gregory G. Colomb, Joseph M. Williams, Joseph Bizup, William T. FitzGerald, Third Edition, The University of Chicago Press, 2008
3. The Elements of Style. William Strunk Jr. and E. B. White, Forth Edition, Pearson, 1999
4. Research Methodology By Panneerselvam R, 2nd Edition, PHI, 2014
5. Statistical Design and Analysis of Experiments With Applications to Engineering and Science, Robert L. Mason, Second Edition, Wiley Inter Science.[Good for Data Analysis and Hypothesis Testing]
6. THE DESIGN OF DESIGN: ESSAYS FROM A COMPUTER CIENTIST, Frederick P. Brooks Jr., Addison-Wesley Professional, 2010.

OEEE6323	Analog and Digital Communication Systems	3-0-0	Credit-3

Course Objectives:

1. Introduction to analog and digital communication systems.
2. Analysis of signal in frequency domain.
3. Study of analog modulation schemes.
4. Study of digital modulation techniques

Module I **(12 Hours)**

Elements of Communication System-Analogue System, Digital System, Distinguishing features. Electromagnetic Spectrum, Bandwidth. Comparison between Analog & Digital Communication Systems. Frequency domain analysis of signals and systems: Fourier series, Fourier Transforms, Power and Energy,

Sampling and Band limited signals, Band pass signals.

Module II (12 Hours)

Introduction to modulation, Amplitude Modulation (AM),Depth of Modulation, Modulated Waveform, Powers in Carrier, and Sidebands, Generation of DSBC and SSB, Balanced Modulator, AM Demodulators. Frequency Modulation (FM) - Frequency Deviation, Frequency Modulated Waveform, Spectrum. Narrow Band FM and Wideband FM. Generation of FM; Narrow Band FM Modulator, Wideband FM Modulator, FM Discriminator, Angle Modulation.

Module III (12 Hours)

Pulse modulation systems: Pulse amplitude modulation, Pulse Time Modulation. Pulse code modulation: PCM system, Inter symbol interference, Time Division Multiplexing of PCM signals, Line codes, Bandwidth of PCM system, Noise in PCM systems, Delta Modulation (DM), Limitations of DM, Adaptive Delta Modulation, Noise in Delta Modulation, Comparison between PCM and DM, Delta or Differential PCM (DPCM), S-Ary System.

Module IV (6 Hours)

Digital Modulation Techniques. Phase Shift Keying (PSK), Frequency Shift Keying (FSK) – their Basic Principle, Waveform, Generation and Detection. Ideal low pass, Band pass and Band rejection filters – their impulse response (no mathematical derivation).

Program Outcomes:

At the end of this course students will demonstrate the ability to

1. Analyse signals in frequency domain.
2. Analyze and compare different analog modulation schemes for their efficiency and bandwidth.
3. Analyze different digital modulation schemes.
4. Investigate pulsed modulation system and analyze their system performance.

TEXT BOOKS:

1. John G.Proakis, M. Salehi, COMMUNICATION SYSTEMS ENGINEERING, 2nd ed. New Delhi, India: PHI Learning Private Limited, 2009.
2. R.P Singh and S.D Sapre, COMMUNICATION SYSTEMS Analog & Digital, 2nd ed. New Delhi, India: Tata McGraw Hill Education Private Limited, 2009.
3. Martin S. Roden, "Analog and Digital Communication Systems", SPD Publisher.

REFERENCE BOOKS:

1. H.Taub and D. L. Shilling, "Principle of Communication System", TMH Publisher.
2. Modern Digital and Analog Communication Systems, by B.P. Lathi, Oxford.

OEEE6436	Internet of Things	3-0-0	3 Credits

Course Objectives:

1. To understand the design of IOT relevant applications in various domain.
2. To understand the concepts of Raspberry Pi, interfaces and applications in IoT domain.
3. To understand the importance of cloud computing and its applications.
4. To understand specific security and data protection issues in IoT

MODULE-I **(12 Hours)**

Unit 1

Introduction & Concepts: Introduction to Internet of Things, Physical Design of IOT, Logical Design of IOT, IOT Enabling Technologies, IOT Levels.

Unit 2

Domain Specific IOTs: Home Automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health & Life Style. Smart Lighting, Intrusion Detection, Smoke/Gas Detectors, Cities-Smart Parking, Smart Lighting, Smart Roads, Environment-Weather Monitoring, Air pollution Monitoring, Forest Fire Detection, Energy-Smart Grids, Logistics-Route Generation & Scheduling, Agriculture Smart Irrigation, Health & Fitness Monitoring.

MODULE-II **(12 Hours)**

Unit 3

M2M: M2M, Difference between IOT and M2M.

Unit 4

IOT Physical Devices & Endpoints: What is an IOT Device, Linux on Raspberry Pi, Interfaces,

Programming: Installing python. Data types and data structures, Flow, Functions, Modules, File Handling, Date/ Time Operations, Classes, Python Packages.

MODULE-III **(12 Hours)**

Unit 5

Design steps of IoT

Design steps of IoT**,** Raspberry Pi, About the Board, Linux on Raspberry Pi.

Unit 6

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 **(8 Hours)**

Unit 7

Privacy and Security threats on internet of Things: Specific security and data protection issues, IoT privacy and security issues in smart cities.

Text Book:

1. Arshdeep Bahga and Vijay Audisetti, "Internet of Things, A Hands on Approach", University Press, 1st edition, 2016.

Reference Books:

1. Sébastien Ziegler, "Internet of Things Security and Data Protection", Springer Publisher, 1st edition, 2019.
2. Adrian McEwen, "Designing the Internet of Things", Wiley, 1st edition, 2015.
3. Miller, "The Internet of Things: How Smart TVs, Smart Cars, Smart Homes and Smart Cities are Changing the World", Pearson, 1stedition, 2015.

Course Outcomes:

1. To analyse applications of IOT in various domain.
2. To realize the revolution of Internet in Mobile Devices, Cloud &Sensor Networks
3. To understand the importance of cloud computing and Embedded system.
4. To understand the challenges and limitations of internet of things.

OEEC6437	Soft Computing	3-0-0	Credits 3

COURSE OBJECTIVES

1. To familiarize with soft computing concepts.
2. To introduce the fuzzy logic concepts, fuzzy principles and relations.
3. To know the basics of ANN and Learning Algorithms.
4. To analyze Ann as function approximation.
5. To know Genetic Algorithm and its applications to soft computing.
6. To analyze Hybrid system usage, application and optimization

MODULE-I (10 Hours)

Unit-1

Introduction

What is Soft Computing? Difference between Hard and Soft computing, Requirement of Soft computing, Major Areas of Soft Computing, Applications of Soft Computing.

Unit-2

Fuzzy Systems

Fuzzy Set theory, Fuzzy versus Crisp set, Fuzzy Relation, Fuzzification, Minmax Composition, Defuzzification Method, Fuzzy Logic, Fuzzy Rule based systems, Predicate logic, Fuzzy Decision Making, Fuzzy Control Systems, Fuzzy Classification.

MODULE-II (12 Hours)

Unit-3

Neural Networks

What is Neural Network, Learning rules and various activation functions, Single layer Perceptron, Back Propagation networks, Architecture of Backpropagation (BP) Networks, Backpropagation Learning, Variation of Standard Back propagation Neural Network.

Unit-4

Introduction to Associative Memory, Adaptive Resonance theory and Self Organizing Map, Recent Applications.

MODULE-III (10 Hours)

Unit-5

Genetic Algorithm

History of Genetic Algorithms (GA), Working Principle, Various Encoding methods, Fitness function.

Unit-6

GA Operators- Reproduction, Crossover, Mutation, Convergence of GA, Bit wise operation in GA, Multi-level Optimization.

MODULE-IV (10 Hours)

Unit-7

Hybrid Systems

Sequential Hybrid Systems, Auxiliary Hybrid Systems, Embedded Hybrid Systems, Neuro-Fuzzy Hybrid Systems, Neuro-Genetic Hybrid Systems, Fuzzy-Genetic Hybrid Systems.

GA based Backpropagation Networks

GA based Weight Determination, K - factor determination in Columns.

Fuzzy Backpropagation Networks

LR type Fuzzy numbers, Fuzzy Neuron, Fuzzy BP Architecture, Learning in Fuzzy BP, Application of Fuzzy BP Networks.

Text Books:

1. S, Rajasekaran & G.A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logic & Genetic Algorithms, Synthesis & applications, PHI Publication, 1st Edition, 2009.
2. F. O. Karry and C. de Silva, “Soft Computing and Intelligent Systems Design – Theory, Tools and Applications”, Pearson Education.

Reference Books:

1. J. S. R. Jang. C. T. SUN and E. Mizutani, “Neuro-fuzzy and soft-computing”. PHI Pvt. Ltd., New Delhi.
2. Fredric M. Ham and Ivica Kostanic, “Principle of Neuro Computing for Science and Engineering”, Tata McGraw Hill.
3. S. Haykins, “Neural networks: a comprehensive foundation”. Pearson Education, India.
4. V. Keeman, “Learning and Soft computing”, Pearson Education, India.
5. R. C. Eberhart and Y. Shi, “Computational Intelligence Concepts to Implementation”. Morgan

Kaufmann Publishers (Indian Reprint).
6. David E. Goldberg, "Genetic Algorithms in search, optimization, and machine learning", Addison-Wesley Publishing Company, Inc, 1989.

Course Outcomes:

1. To analyze the facts and outline the different process carried out in fuzzy logic, ANN and Genetic Algorithms.
2. To understand the concepts and meta-cognitive of soft computing.
3. To Apply Soft computing techniques the solve character recognition, pattern classification, regression and similar problems.
4. To identify process/procedures to handle real world problems using soft computing.
5. To apply various techniques of soft computing to defend the best working solutions.
6. To Design hybrid system to revise the principles of soft computing in various applications.

OEME6438	Reliability Engineering	3-0-0	Credit-3

OBJECTIVES:

To stress the importance of reliability in Engineering and products also the concept of maintainability, failure modes and testing methods.

UNIT I: CONCEPTS OF RELIABILITY, SYSTEM AND MODELS [12 Hours]

Definition of reliability – reliability Vs quality-reliability function-MTTF – hazard rate function- bathtub curve – derivation of the reliability function-constant failure rate model – time dependent failure models. Weibull distribution – normal distribution – the lognormal distribution. Serial configuration – parallel configuration – combined series parallel systems – system structure function, minimal cuts and minimal paths – Markov analysis – load sharing systems, standby system, degraded systems, three state devices – covariate models, static models, dynamic models, physics of failure models.

UNIT II : DESIGN FOR RELIABILITY AND MAINTAINABILITY [12 Hours]

Reliability design process – system effectiveness – economic analysis and life cycle cost – reliability allocation – optimal, Arinc, Agree, – Design methods – parts and material selection, derating, stress- strength analysis – failure analysis – identification of failure mode – determination of causes –assessment of effects – classification of seventy – computation of critically index – corrective action – system safety and FTA. Analysis of downtime – the repair time distribution – stochastic point processes – system repair time – reliability under preventive maintenance – state dependent systems with repair – MTTR-mean system downtime – MTR – MH/OH – cost model – fault isolation and self-diagnostics – repair Vs replacement – replacement model – proactive, preventive, predictive

Maintenance – maintenance and spares provisioning – maintainability prediction and demonstration – concepts and definition of availability.

UNIT III: OPTIMIZATION OF SYSTEM RELIABILITY [7 Hours]

Optimization techniques for system reliability with redundancy – heuristic methods applied to optimal system reliability- redundancy allocation by dynamic programming – reliability optimization by non linear

programming.

TEXT BOOKS:

1. Charles E. Ebling, "An introduction to Reliability and Maintainability Engg", Tata McGraw-Hill, 2000.

REFERENCES:

1. Patrick D T O'Connor, "Practical Reliability Engineering", John-Wiley and Sons inc, 2002.
2. David J Smith, "Reliability, Maintainability and Risk: Practical Methods for Engineers", Butterworth, 2002
3. Way kuo, Rajendra Prasad V, Frank A and Tillman, ching- lai Hwang "Optimal Reliability Design and Applications", Cambridge University Press P ltd., 2001.
4. Srinath I.S, Engineering Design and Reliability, ISTE, 1999.
5. Oleg Vinogradov, "Introduction to Mechanical Reliability: A Designers Approach, Hemisphere Publications, 1991.

OUTCOMES

The Student must apply and optimize reliability for time independent and time dependent failure models through various testing methods for various manufacturing amnesty process

OEME6439	Robotics	3-0-0	Credit-3

Course objective:

To expose students to the automation, robot kinematics and robot arm dynamics. To acquire knowledge on Classification and structure of robotic system, robot programming and its applications.

Module I **(13 Hours)**

Introduction, Automation and Robotics, brief history, Social and economic aspects, Advantages overview of robots and future application; Classification & structure of robotic system: Classification, Configuration, wrist, end effectors, Links, Joints, Drive system; Control System: Basic control system concepts, model, transformation and block diagrams, controllers ON & OFF, transient response.

Module II **(11 Hours)**

Robot Kinematics: Direct & inverse kinematics, rotation matrix, composite rotation matrix, homogenous transformations, links, joints D-H representation, Geometrical approach of direct & reverse kinematics; Robot Arm dynamics: Joint velocities, KE, PE & motion equation of manipulating trajectory planning, joint interpolated trajectory

Module III **(9 Hours)**

Robot Programming: Languages, Graphics, Storing & operating, Task programs; Sensors: State and external state sensors, tactile and non-tactile sensors, force – torque sensors, Image processing & analysis, Computer vision.

Essential Reading:

1. Groover, Industrial Robot, PHI. 2. Y. Korem, Robotics, Mc Graw-Hill.

Course Outcomes:

1. Complete knowledge of robotic system
2. Idea about robot kinematics and robot arm dynamics
3. Learning of robot languages and the use of sensors

OEMT6440	Nanocomposites	3-0-0	Credits 3

Objectives of the Course:

To become familiar with nanocomposite processing, properties and their applications in the engineering.

Module-I: (12 hours)

Introduction to nanocomposites, composite materials, mechanical properties of nanocomposite materials, stress strain relationship, toughness, strength, plasticity, Ceramic matrix nanocomposites, Different types, Synthesis (Conventional powder method; Polymer precursor route; Spray pyrolysis; Vapour techniques (CVD and PVD) and Chemical methods, which include the sol-gel process, colloidal and precipitation approaches and the template synthesis). Structure, Properties and New Application

Module-II: (10 hours)

Metal matrix nanocomposites, Different types, Synthesis(Spray pyrolysis; Liquid metal infiltration; Rapid solidification; Vapour techniques (PVD, CVD); Electro deposition and Chemical methods, which include colloidal and sol-gel processes), Structure, Properties and New Application, ceramic-metal nanocomposites, Different types, Synthesis, Structure, Properties and New Application

Module-III: (10 hours)

Polymer Matrix nanocomposites (PMNC): Different types synthesis (Intercalation / Prepolymer from Solution In-situ Intercalative Polymerization, In situ polymerization Mixing, Melt Intercalation), structure, Properties and New Application

Module-IV: (10 hours)

Carbon nanotubes Nanocomposites: Different types, Synthesis, Structure, Properties and New Application, Natural nano-biocomposites, bio-mimetic nanocomposites and biologically inspired nanocomposites: Different types, Synthesis, Structure, Properties and New Application

Suggested Reference Books:

1. P. M. Ajayan, L. S. Schadler and P. V. Braun, Nanocomposite Science and Technology, Wiley-VCH, 2003.
2. C. P. Poole and F. J. Owens, Introduction to Nanotechnology, Wiley Interscience 2003.

3. H. S. Nalwa, Encyclopaedia of Nanotechnology, 2004.
4. Chung; Deborah D. L., Composite Materials: Science and Applications, Spinger International Edition, Springer-Verlag, London (2004)-Indian Edition 2006.

Course Outcomes:

1. Students will be able to identify nanocomposites for a given application
2. Understanding properties of a nanocomposite by relating them to its structure
3. Identifying a suitable nanocomposite process for a given application
4. Applying nanocomposite fundamentals in real life situations

OEPD6441	INDUSTRIAL MANAGEMENT	3L-0T-0P	3 Credits

Course Objective

The objective of this course is to produce graduates who Contribute to the success of companies through effective problem solving. Design, develop, implement, and improve integrated systems that include people, materials, information, equipment, and environments.

Module I **[12]**

Basic Management Theory: Evolution of Management Thought, Scientific Management, Organization as a System, Function of Management, Principles of Management, Planning, Decision Making, Organizing Principle, Delegation of Authority, Line and Staff Function, Leadership, Motivation, Communication, Controlling.

Module II **[10]**

Personnel Management: Organization as Social System, Motivation and Behaviour, Role of Personnel Management, Recruitment, Selection, Training, Performance Appraisal, Job Evaluation and Merit Rating, Wage Policy, Incentives, Group Dynamics, Job Satisfaction and Morale.

Materials Management: Purchasing, Selection of Vendor, Learning Curve Concept, MRP.

Module III **[10]**

Marketing Management: Selling and Marketing Concept, Role of Marketing Management in the Process of Marketing Management, Product Life Cycle, New Product Development Strategy, Market Research, Consumer Behaviour, Sales Promotion Advertising, Pricing Strategy, Break even analysis, Channel of Distribution.

Module IV **[08]**

Financial Management: Scope, Time Value of Money, Depreciation cost of a product, Financial Statement Analysis, Ratio Analysis, Working Capital, Sources of Finance.

Industrial Relation: Trade Union, Industrial Dispute, Workers Participation In Management, Industrial Legislation, Labour Law, Factory Act.

Text Books:

1. Industrial Engineering & Production Management, M. Mahajan, Dhanpat Rai Publication.
2. Industrial Engineering & Management Science, T. R. Banga, N. K. Agarwal, S. C. Sharma, Khanna

Publication.

Reference Books:

1. Personnel Management, A. Mannappa, M. S. Saiyadain.
2. Fundamentals of Financial Management, Prasanna Chandra, TMH.

Course Outcomes:

Upon successful completion of the course, student will able to:

1. Understand the theories and principles of modern management.
2. Apply the concepts to the management of organisations in private and public sector
3. Understand how managers can effectively plan in today's dynamic environment.
4. Be familiar with the design of organisation structure.
5. Describe how environmental uncertainty affects organisation design

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

B.TECH SYLLABUS for MECHANICAL ENGINEERING

(Admission Batch: 2018-19 Onwards)

8th Semester

PEME5413	Ergonomics and Human Factor Engineering	3-0-0	Credit-3

Course Objectives:

To understand the concept of human activities and improve the effectiveness in an organizations.

Module I **(10 hours)**

Introductory Concepts: Definition, objective and scope of work study and ergonomics and its historical background, Interrelationship between work study & ergonomics, role of work study & ergonomics in productivity improvement

Method Engineering Definition, objectives and procedure of method analysis, Principles of motion economy and methodology of motion analysis.

Module II **(10 hours)**

Work Measurement: Definition, objective and different methods of work measurement – stop watch time study, predetermined motion time system (PMTS) ,Work Sampling ,Principle, techniques and applications of work sampling studies.

Module III **(13 hours)**

Job Evaluation and Merit Rating, Definition, objectives and techniques of job evaluation and merit rating, Wages & Salary, Definition and principles of wage and salary administration, comparative study of incentive schemes Ergonomics

Man – machine interaction, design of man-machine environment system, workstation design.

TEXT BOOKS

1. Motion & Time Study Barnes Ralph. M., John Wieley & Sons, 7 th edition.
2. Work Study O. P. Khanna, Dhanpat Rai & sons, New Delhi
3. Motion and Time study – Principles and Practice M.E.MUNDEL PRENTICE Hall India Pvt. Ltd.
4. Introduction to work Study – ILO
5. Human Factors in Engineering Design – E.J. McCormick, Tata Mc-Graw Hill
6. Hand book of Ergonomic Design – Martin Helender

PEME5414	Gas Dynamics	3-0-0	Credit-3

Course Objective:

1. Ability to know the basic concept of compressible flow, Wave propagation
2. Ability to know about flow with friction and heat transfer
3. Ability to solve problems related to compressible flow

MODULE-I

Basic concept of compressible flow: Thermodynamic of fluid flow, 1st and 2nd law of thermodynamics, perfect gas, Governing equation of – mass conservation equation, momentum conservation equation and energy conservation equation.

Module II

One dimension of compressible flow: Introduction, Isentropic conditions, speed of sound, Mach number, area velocity relations, normal shock relations for a perfect gas, Rayleigh flow, De-Laval nozzle, diffusers.
Wave propagation: Introduction, velocity of sound, subsonic and supersonic flows.

Module III

Flow with friction and heat transfer: Introduction, flow in constant area duct with friction, Adiabatic-constant area flow of perfect gas, flow with heating and cooling in duct, importance of high temperature flow and nature of high temperature flow, shock-shock interaction of different family and same family, shock reflection.

Module IV

Measurement in compressible flow: Introduction, pressure and temperature measurement, velocity and direction measurement, velocity potential equation, method of characteristics and application of method of characteristics.

References

1. H. W. Liepmann and A. Roshko, Elements of Gas Dynamics, John Wiley, 1960.
2. J. D. Anderson, Modern Compressible Flow, McGraw Hill, 1989.
3. B. K. Hodge and C. Koenig, Compressible Fluid Dynamics (with P.C. applications), PH, 1995.
4. H. Shapiro, The Dynamics and Thermodynamics of Compressible Flow, Ronald Press, 1954.
5. R. D. Zucker and O. Biblarz, Fundamentals of Gas Dynamics, Wiley, 2002.

Upon successful completion of the course, student will have:

1. Understand the basic fundamental equation compressible flow.
2. Describe the working principle for measurement in compressible flow.
3. Understand the concept of wave propagation.
4. Understand the concept of speed of sound, Mach number and shock reflection.
5. Concept of supersonic speed, understand of this flow regime and its characteristic

PEME5415	Finite Element Method	3-0-0	Credit-3

Course Objective:

1. To introduce the concepts of Mathematical Modeling of Engineering Problems.
2. To appreciate the use of FEM to a range of Engineering Problems.

MODULE – I Introduction (9 HOURS)

Historical Background – Mathematical Modeling of field problems in Engineering – Governing Equations – Discrete and continuous models – Boundary, Initial and Eigen Value problems–Weighted Residual Methods – Variational Formulation of Boundary Value Problems – Ritz Technique – Basic concepts of the Finite Element Method.

MODULE – II One-Dimensional Problems (9 HOURS)

One Dimensional Second Order Equations – Discretization – Element types- Linear and Higher order Elements – Derivation of Shape functions and Stiffness matrices and force vectors- Assembly of Matrices - Solution of problems from solid mechanics and heat transfer. Longitudinal vibration frequencies and mode shapes. Fourth Order Beam Equation –Transverse deflections and Natural frequencies of beams.

MODULE – III Two Dimensional Scalar Variable Problems (9 HOURS)

Second Order 2D Equations involving Scalar Variable Functions – Variational formulation –Finite Element formulation – Triangular elements – Shape functions and element matrices and vectors. Application to Field Problems - Thermal problems – Torsion of Non circular shafts –Quadrilateral elements – Higher Order Elements.

MODULE – IV Two Dimensional Vector Variable Problems (9 HOURS)

Equations of elasticity – Plane stress, plane strain and axisymmetric problems – Body forces and temperature effects – Stress calculations - Plate and shell elements.

TEXT BOOKS

1. Reddy. J.N., “An Introduction to the Finite Element Method”, 3rd Edition, Tata McGraw-Hill, 2005
2. Seshu, P, “Text Book of Finite Element Analysis”, Prentice-Hall of India Pvt. Ltd., New Delhi, 2007.

REFERENCES

1. Rao, S.S., “The Finite Element Method in Engineering”, 3rd Edition, Butterworth Heinemann, 2004
2. Logan, D.L., “A first course in Finite Element Method”, Thomson Asia Pvt. Ltd., 2002
3. Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, “Concepts and Applications of Finite Element Analysis”, 4th Edition, Wiley Student Edition, 2002.
4. Chandrupatla & Belagundu, “Introduction to Finite Elements in Engineering”, 3rd Edition, Prentice Hall College Div, 1990
5. Bhatti Asghar M, "Fundamental Finite Element Analysis and Applications", John Wiley & Sons, 2005 (Indian Reprint 2013)*

Course Outcome

On successful completion of the course students will be able to:

Understand different mathematical techniques used in FEM analysis and use of them in Structural and thermal problem

PEME5416	Engineering Tribology	3-0-0	Credit-3

Course Objective

1. Apply the basic theories of friction, wear and lubrication to predictions about the frictional behavior of commonly encountered sliding interfaces.
2. Characterize features of rough surface and liquid lubricants as they pertain to interface sliding.
3. Interpret the latest research on new topics in tribology including its application to nano-scale devices and biological systems.

Module 1: **[12]**

Introduction: Lubricant and lubrication, Types of bearings, properties and testing of lubricants, Basic equations: Generalized Reynolds equation, Flow and Shear Stress, Energy equation, Equation of state.
Hydro dynamic lubrication: Mechanism of pressure development and load carrying capacity, Plane-slider bearing, Idealized slider bearing with a pivoted shoe, Step bearing, Idealized journal bearing. – infinitely long journal bearing, Petroffs equation for a lightly loaded bearing, narrow bearing

Module 2: **[11]**

Oil flow and thermal equilibrium - Heat balance of lubricants Hydrostatic Bearing: Principles, Component of hydrostatic lubrication , Hydrostatic circular thrust bearing , calculation of pressure, load carrying capacity, flow rate , power loss in bearing due to friction.

Module 3: **[12]**

Concept of gas lubricated bearing Concept of Elasto-hydrodynamic lubrication, Design and selection of antifriction bearing Friction and wear of metals: Theories of friction, surface contaminants, Effect of sliding speed on friction, classification and mechanism of wear, Wear resistant materials.

Text/Reference Books:

1. Introduction to Tribology of Bearing, B.C .Majumdar , S. Chand & Co.
2. Fundamentals of Tribiology, Basu S K., Sengupta A N., Ahuja B. B., PHI 2006.
3. Basic Lubrication theory, A. Cameron, John Wiley & sons 3. Lubrication Fundamentals, D.M. Pirro and A.A. Wessol, CRC Press.
4. Theory and Practice of Lubrication for Engineers, Fuller, D., New York company 1998.
5. Principles and Applications of Tribiology, Moore, Pergamaon press 1998.
6. Tribology in Industries, Srivastava S., S Chand and Company limited, Delhi 2002.
7. Lubrication of bearings – Theoretical Principles and Design, Redzimovskay E I., Oxford press company 2000

Upon successful completion of the course, student will have:

1. Ability to know about the basics of tribology and related sciences, theoretical background about processes in tribological system, mechanisms and forms of interaction of friction surfaces.
2. Understanding on Hertz contact and rough surface contact;
3. Familiarity with adhesion theories and the effect of adhesion on friction and wear;
4. A mastery of the friction/lubrication mechanisms and know how to apply them to the practical engineering problem.
5. Know the methods to reduce the friction for engineering surface.

PEME5417	Automobile Engineering	3-0-0	Credit-3

Course Objective:

1. Understand the basic layout of Automobile and vehicle resistances
2. Understand the principles of transmission system in Automobile.
3. Understand the vehicle steering and braking system
4. Understand the suspension system, automotive electrical and electronic system and Study of development of non-conventional automobiles

Module-1

INTRODUCTION: **Development of Automobiles, concept of automobile, m**ain units of automobile, chassis and body, different system of automobiles, descriptions and materials of main parts of the engine, cylinder head, cylinder block, cylinder liner, crank case, piston, piston rings, piston pin, connecting rod, crank shaft, bearing, valve, valve driving mechanism.

POWER PROPULSION: Resistance to motion, rolling resistance, air resistance, gradient resistance, calculation of power required for propulsion, tractive effort and traction, road performance curves.

Module-2

TRANSMISSION SYSTEM:

CLUTCH: principles of clutch, single plate clutch, multiplate clutch, centrifugal clutch, electromagnetic clutch, clutch lining, friction materials, bonding materials.

GEAR BOX: sliding mesh, constant mesh and synchromesh gear box, overdrive, epicyclic gear box, torque converter, automatic transmission, transfer case.

Hooke's joint, Propeller shaft, Differential, Rear axle, Types of rear axle, semi-floating, three quarter floating and full floating types. Different types of rear axle drives, Hotch kiss and torque tube drive.

Module-3

BRAKING SYSTEM: Requirement of brakes, brake efficiency and stopping distance, **Braking of Vehicle when applied to rear, front and all four wheels**, brake lining material, hydraulic brakes, master cylinder, tandem master cylinder, power brakes, drum brakes, disc brakes, parking brakes, **Antilock brake system**, pressure modulation, components of antilock brake system, Non integral and integral antilock system.

Front wheel geometry and steering system: Camber, Castor, Kingpin indicator. Toe-in, Centre point steering, condition for true rolling, Akerman and Davis steering, components of steering mechanism, Power steering.

Module-4

SUSPENSION SYSTEM: Introduction, functions and requirement of suspension system, element of suspension system. Springs, Damper, types of suspension system, wheels and tyres.

ELECTRICAL AND ELECTRONIC SYSTEM OF AUTOMOBILE: Starting system and starting drive, Generating system, Igniting system and their electrical system. Recent advances in automotive electronic such as multipleying, sensors and actuators.

ELECTRICAL VEHICLES: History, electrical vehicles and the environment pollution, description of electric vehicle, operational advantages, present EV performance and applications, battery for EV, Battery types and fuel cells, Solar powered vehicles, hybrid vehicles.

TEXT BOOKS

1. "Automobile Engineering", K. M. GUPTA Vol I & II, Umesh Publication
2. "Automobile Engineering", Sudhir Kumar Saxena, University Science Press
3. "Automobile Engineering", R. K. RAJPUT, S. Chand Publishers
4. "Automobile Mechanics", Dr. N. K. GIRI, Khanna Publishers

REFERENCE BOOKS

1. Automobile Engg. By K.M. Gupta.l, Vol.I & II, Umesh Publishers
2. Automotive mechanics: William h. Crouse and Donald L. Anglin, TMH
3. The motor vehicle, Newton and Steeds
4. Automobile Mechanics, J. Heitner, East West Press
5. Automobile Engineering, Jain and Asthana, Tata McGraw Hill
6. Automobile Engineering, K.K.Ramalingam, Scitech
7. Automobile Engineering, Vol. I & II, Kirpal Singh, Standard Publications
8. A Text Book of Automobile Engineering, R.K.Rajput, Laxmi Publishers

PEME5418	Optimization in Engineering	3-0-0	Credit-3

Module-I **(10 Hours)**

Idea of Engineering optimization problems, Classification of optimization algorithms, Modeling of problems and principle of modeling. Linear programming: Formulation of LPP, Graphical solution, Simplex method, Big-M method, Revised simplex method, Duality theory and its application, Dual simplex method , Sensitivity analysis in linear programming

Module-II **(10 Hours)**

Transportation problems: Finding an initial basic feasible solution by Northwest Corner rule, Least Cost rule, Vogel's approximation method, Degeneracy, Optimality test, MODI method, Stepping stone method

Assignment problems: Hungarian method for solution of Assignment problems Integer Programming: Branch and Bound algorithm for solution of integer Programming Problems Queuing models: General characteristics, Markovian queuing model, M/M/1 model, Limited queue capacity, Multiple server, Finite sources, Queue discipline.

Module-III (10 Hours)

Non-linear programming: Introduction to non-linear programming. Unconstraint optimization: Fibonacci and Golden Section Search method. Constrained optimization with equality constraint: Lagrange multiplier, Projected gradient method Constrained optimization with inequality constraint: Kuhn-Tucker condition, Quadratic programming Introduction to Genetic Algorithm.

Recommended text books

1. A. Ravindran, D. T. Philips, J. Solberg, " Operations Research- Principle and Practice", Second edition, Wiley India Pvt Ltd
2. Kalyanmoy Deb, " Optimization for Engineering Design", PHI Learning Pvt. Ltd
3. Stephen G. Nash, A. Sofer, " Linear and Non-linear Programming", McGraw Hill
4. A. Ravindran, K.M. Ragsdell, G.V.Reklaitis," Engineering Optimization", Second edition, Wiley India Pvt. Ltd
5. H.A.Taha, A.M. Natarajan, P.Balasubramanie, A. Tamilarasi, "Operations Research", Eighth Edition, Pearson Education
6. F.S.Hiller, G.J.Lieberman, " Operations Research", Eighth Edition, Tata McGraw Hill
7. P.K. Gupta, D.S. Hira, "Operations Research", S. Chand and Company Ltd.