Course Structure and Syllabus
of
M.Tech Programme
In

TRANSPORTATION ENGINEERING

BRANCH: CIVIL ENGINEERING

(From the Session 2018-19)

INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG
(An Autonomous Institute of Government of Odisha)
Dhenkanal, Odisha- 759146
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INDIRA GANDHI INSTITUTE OF TECHNOLOGY, SARANG

M.TECH SYLLABUS for *Specialization*: TRANSPORTATION ENGINEERING

BRANCH: CIVIL ENGINEERING

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				
TRE301	Intelligent Transportation system						
TRE302	Environmental Impact Assessment						
TRE303	Bridge Engineering						
	Open Elective (Any One)	3-0-0	3				
OHM301	Business Analytics						
OME301	Industrial Safety						
OMA301	Operations Research						
OCE302	Cost Management of Engineering Projects						
OMT301	Composite Materials						
OCE301	Waste to Energy						
OEC301	Internet of Things						
OEC302	Soft Computing						
OCE303	Project Engineering & Management						
OME302	Start-up & Entrepreneurship Development						
	Total (Theory)	**6**	**6**		**Total (Theory)**	**0**	**0**
	Practical/ Sessional				**Practical/ Sessional**		
TRJ301	Dissertation Phase-I	0-0-20	10	TRJ401	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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3rd Semester

TRE301	Intelligent Transportation System	3-0-0	Credits 3

Course Objectives:

1. To learn about basics of ITS.
2. To learn about various types of ITS models and evaluation methods.
3. To learn about applications of ITS for sustainable mobility.

MODULE-I

Fundamentals of ITS: Definition of ITS, the historical context of ITS from both public policy and market economic perspectives, Types of ITS; Historical Background, Benefits of ITS. Sensor technologies and Data requirements of ITS: Importance of telecommunications in the ITS. Information Management, Traffic Management Centers (TMC). Application of sensors to Traffic management; Traffic flow sensor technologies; Transponders and Communication systems; Data fusion at traffic management centers; Sensor plan and specification requirements; Elements of Vehicle Location and Route Navigation and Guidance concepts; ITS Data collection techniques – Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), GIS, video data collection.

MODULE-II

ITS User Needs and Services and Functional areas – Introduction, Advanced Traffic Management systems (ATMS), Advanced Traveller Information systems (ATIS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control systems (AVCS), Advanced Public Transportation systems (APTS), Advanced Rural Transportation systems (ARTS). ITS Architecture – Regional and Project ITS architecture; Concept of operations; ITS Models and Evaluation Methods; Planning and human factor issues for ITS, Case studies on deployment planning and system design and operation; ITS and safety, ITS and security, ITS as a technology deployment program, research, development and business models, ITS planning.

MODULE-III

ITS applications: Traffic and incident management systems; ITS and sustainable mobility, travel demand management, electronic toll collection, ITS and road-pricing.; Transportation network operations; commercial vehicle operations and intermodal freight; public transportation applications; 37 ITS and regional strategic transportation planning, including regional architectures: ITS and changing transportation institutions Automated Highway Systems- Vehicles in Platoons – Integration of Automated Highway Systems. ITS Programs in the World – Overview of ITS implementations in developed countries, ITS in developing countries.

Text/ Reference Books:

1. Fundamentals of intelligent transportation systems planning By Mashrur A. Chowdhury, Adel Wadid Sadek.
2. Sensor technologies and Data requirements of ITS, Lawrence A. Klein
3. ITS Hand Book 2000: Recommendations for World Road Association (PIARC) by Kan Paul Chen, John Miles.
4. Perspective on ITS, Artech House Publishers, Sussman, J. M.

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

1. Collect data and analyze for ITS.
2. Develop ITS models.
3. Apply ITS for sustainable mobility

TRE302	Environmental Impact Assessment	3-0-0	Credits 3

Course Objectives:

1. To learn about the importance of Environmental Impact Assessment.
2. To understand the methods followed for the impact assessment.
3. To understand the socio-economic aspects.

MODULE-I

Technical and procedural aspects of Environmental Impact assessment, Guidelines and legal aspects of environmental protection. General Framework for characterizing environmental dislocation/disruption due to pollution.

MODULE-II

Theory and application of mathematical models: - Mathematical modelling for water quality systems, Stream and Estuarine models for pollution control.

MODULE-III

Socio-economic aspects, Measures of effectiveness of pollution control activities, Inter-sector pollutant transfers, total impact assessment.

Text/ Reference Books:

1. Environmental Impact Assessment, L.W. Canter, McGraw Hill International Edition.
2. Environmental Impact Assessment- A Practical Guide, B. B. Marriot, McGraw- Hill International Edition.
3. Environmental Impact Assessment- Theory and practice, London

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

1. Analyze importance of Environmental Impact Assessment.
2. Learn the methods followed for the impact assessment.
3. Learn the socio-economic aspects.

TRE303	Bridge Engineering	3-0-0	Credits 3

Course Objectives:

1. To learn about types of bridge and types of load.
2. To learn about the design of different structures.
3. To learn about the cantilever and long span bridge.

MODULE-I

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. Tee beam and slab bridge deck, design of prestressed concrete bridge.

MODULE-III

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. IndianRoad Congress Codes No.5, 6,18,21,24, Jamnagar House, Shah Jahan Road,New Delhi.

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

1. Understand about the bridge.
2. Design the different bridge structure.
3. Design the cantilever bridge and continuous bridge.

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3rd Semester

TRJ301	Dissertation Phase-I	0-0-20	Credits 10
Literature review, Experimental / Numerical Modelling work, report writing, presentation and viva voce.			

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4th Semester

TRJ401	Dissertation Phase-II	0-0-32	Credits 16
Literature review, Experimental / Numerical Modelling work, Final report writing, presentation and viva voce evaluated by external examiner and department committee.			

M.Tech 3rd Semester

Open Elective Papers

OHM301	Business Analytics	3-0-0	Credits 3

Course objectives

1. Understand the role of business analytics within an organization.
2. Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
3. To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
4. To become familiar with processes needed to develop, report, and analyze business data.
5. Use decision-making tools/Operations research techniques.
6. Mange business process using analytical and managementtools**.**
7. Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

SYLLABUS

Module-I:
Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics.
Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

Module-II:
Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression.
Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

Module-III:
Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes.
Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

Module-IV:
Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models.
Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

Module-V:

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.

Module-VI:
Recent Trends in: Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

COURSE OUTCOMES

1. Students will demonstrate knowledge of data analytics.
2. Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.
3. Students will demonstrate the ability to use technical skills in predicative and prescriptive modelling to support business decision-making.
4. Students will demonstrate the ability to translate data into clear, actionable insights.

Reference:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

OMA301	Operations Research	3-0-0	Credits 3

MODULE-I **(14 Hours)**

Linear Programming (LP): Introduction: Classification of optimization problems, mathematical models in engineering optimization. Concepts in linear optimization: General simplex method, revised simplex method, duality, decomposition principle, Integer Programming: Formulating integer programming problems, the branch-and-bound algorithm for pure integer programs, the branch-and bound algorithm for mixed integer programs and the Gomory algorithm, post optimality analysis.

Transportation & Assignment Problems: Mathematical statement of transportation problem, methods of finding Basic Feasible Solution, test of optimality MODI'S method for optimal solution. Traveling salesman problem as an Assignment problem, Goal programming.

MODLE-II **(14 Hours)**

Network Analysis: Network definition and Network diagram, probability in PERT analysis, project time cost trade off, introduction to resource smoothing and allocation.

Sequencing: Introduction, processing N jobs through two machines, processing N jobsthrough three machines, processing N jobs through m machines.

Inventory Model: Inventory control problem; Concept of inventory and various costs, EOQ formula. Single period models, newspaper boy problems-provisioning of spares with or without salvage value. Different models, Comparison of different models-evaluation of system consequences. Carrying out an inventory control study-relevant costs to be considered, estimation of costs by imputation or otherwise, ABC analysis and Selective inventory management, Decaying inventory.

MOULE-III (14 Hours)

Queuing Models: Introduction to waiting line models – steady state behavior of M/M/1 and M/M/C queues-the problem of machine interference and use of finite queuing tables-introduction to M/G/1, and G/M/1. Role of Poison & exponential distribution, concepts of birth and death process.

Replacement & Maintenance Models: Replacement of items, subject to deterioration of items subject to random failure group vs. individual replacement policies.

Non-linear programming: Introduction to non-linear programming. Lagrange multiplier, Kuhn-Tucker condition.

Text Books:

1. J. K. Sharma: Fundamentals of Operations Research, Macmillan.
2. F.S. Hiller and G. J. Lieberman, Introduction to Operations Research (**6th**Edition), McGraw-Hill International Edition, 1995.
3. S. Kalavathy,Operations Research,Vikas Publishing House Pvt. Ltd.
4. M.K. Starr and R.J. Tersine, Material Management in Inventory Systems, North Holland.

Reference Books:

1. Kanti Swarup, P. K. Gupta and Man Mohan, Operations Research- AnIntroduction, S. Chand & Company.
2. D. R. Anderson, D. J. Sweeney and T. A. Williams, An Introduction to Management Science, St. Paul West Publishing Company, 1982.
3. S. D. Sharma, Operations Research, Kedar Nath and Ram Nath, Meerut, 1995.
4. H. A. Taha, Operations Research –An introduction, PHI
5. J.W. Prichard and R.H. Eagle, Modern Inventory Management, John Wiley
6. Ravindran, Philips, Solberg, Operations Research Principles and Practices, Wiley India Edition.

OEC301	Internet of Things	3-0-0	Credits 3

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.

MODULE-I (14 Hours)

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

Domain Specific IOTs: Home Automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health & Life Style.

MODULE-II (12 Hours)

M2M & System Management with NETCONF-YANG: M2M, Difference between IOT and M2M, SDN and NFV for IOT, Software defined Networking, Network Function Virtualization, Need for IOT Systems

Management, Simple Network Management Protocol, Limitations of SNMP, Network Operator Requirements, NETCONF, YANG, IOT Systems management with NETCONF-YANG.

MODULE-III (6 Hours)

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

MODULE-IV (10 Hours)

Applications and Case Studies: 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. 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.

Text Books:

1. ArshdeepBahga 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. 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.

OEC302	Soft Computing	3-0-0	Credits 3

COURSE OBJECTIVES

1. To introduce soft computing concepts and techniques and foster their abilities in designing appropriate technique for a given scenario.
2. To implement soft computing based solutions for real-world problems.
3. To give students knowledge of non-traditional technologies and fundamentals of artificial neural networks, fuzzy sets, fuzzy logic, genetic algorithms.
4. To provide student a hands-on experience to implement various strategies.

MODULE-I (14 Hours)

Introduction to Soft Computing and Neural Networks

Evolution of Computing: Soft Computing Constituents, From Conventional AI to Computational Intelligence:

Machine Learning Basics.

Fuzzy Logic
Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions: Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems:Mamdani fuzzy models, Sugeno Fuzzy Models.

MODULE-II (12 Hours)

Neural Networks
Machine Learning using Neural Network, Adaptive Networks: Architecture, Back propagation for feed forward networks, Extended back propagation for recurrent networks, Hybrid learning rule: steepest descent and LSE.

Supervised Learning Neural Networks
Perceptions, Adaline, Back propagation multi-layer perceptions, Radial Basic Function networks.

Unsupervised Learning Neural Networks
Competitive learning networks, Kohonen self-organizing networks, learning vector quantization, Hebbian learning and the Hopfield network.

MODULE-III (8 Hours)

Genetic and Evolutionary Algorithms
Introduction to Genetic Algorithms (GA), Evolutionary Algorithm, Applications of GA and Evolutionary Algorithm in different domains.

MODULE-IV (8 Hours)

Bio Inspired Algorithms

Particle swarm optimization, Ant Colony Optimization, Grasshopper optimization Algorithm, Simulated Annealing, Social Spider Optimization Technique.

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. Vijay Lakshmi 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. To identify and describe soft computing techniques and their roles in building intelligent machines.
2. To apply fuzzy logic and reasoning to handle uncertainty and solve various engineering problems.
3. To apply genetic and Evolutionary algorithms to combinatorial optimization problems.
4. To evaluate and compare solutions by various soft computing approaches for a given problem.

OME301	INDUSTRIAL SAFETY	3L-0T-0P	Credits 3

Module-I **(10 Hours)**

CONCEPTS AND TECHNIQUES: History of Safety movement –Evolution of modern safety concept-general concepts of management –planning for safety for optimization of productivity -productivity, quality and safety-line andstaff functions for safety-budgeting for safety policy. Incident Recall Technique disaster control, job safety analysis, safety survey, safety inspection, safety sampling, evaluation of performance ofsupervisors on safety.

Module-II **(12 Hours)**

BIOLOGICAL AND ERGONOMICAL HAZARDS

Classification of Bio hazardous agents – examples, bacterial agents, rickettsial and chlamydial agents, viral agents, fungal, parasitic agents, infectious diseases - Biohazard control program, employee health program-laboratory safety program-animal care and handling-biological safety cabinets building design. Work Related Musculoskeltal Disorders –carpal tunnel syndrome CTS- Tendon pain-disorders of the neck- back injuries.

Module-III **(10 Hours)**

Hazardous waste management in India waste identification, characterization and classification technological options for collection, treatment and disposal of hazardous waste selection charts for the treatment of different hazardous wastes methods of collection and disposal of solid wastes

Module-IV **(8 Hours)**

SAFETY EDUCATION AND TRAINING

Importance of training-identification of training needs-training methods – programmes, seminars, conferences, competitions – method of promoting safe practice - motivation – communication - role of government agencies and private consulting agencies in safety training – creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign – Domestic Safety and Training.

TEXT BOOK

1. Rao, CS, "Environmental pollution engineering:, Wiley Eastern Limited, New Delhi, 1992.
2. S.P.Mahajan, "Pollution control in process industries", Tata McGraw Hill Publishing Company, New Delhi, 1993.
3. Varma and Braner, "Air pollution equipment", Springer Publishers, Second Edition
4. Hand book of "Occupational Safety and Health", National Safety Council, Chicago, 1982

REFERENCE

1. Encyclopedia of "Occupational Health and Safety", Vol.I and II, published by International Labour Office, Geneva, 198

OME302	START UP & ENTREPRENEURSHIP DEVELOPMENT	3L-0T-0P	Credits 3

Module-I **(08 Hours)**

Entrepreneurship- definition, growth of small scale industry lies in developing countries and their positions vis-avis large industries, role of small scale industries in the national economy, characteristics and types of small scale industries; demand based and resources based ancillaries and sub-control types. Government policy for small scale industry; stages in starting a small scale industry. All the government norms for startup Program

Module-II **(06 Hours)**

Project identification- assessment of viability, formulation, evaluation, financing, field-study and collection of information, preparation of project report, demand analysis, material balance and output methods, benefit cost analysis, discounted cash flow, internal rate of return and net present value methods.

Module-III **(06 Hours)**

Evaluation of E-Business Infrastructure and Capacity Planning: Quantitative analysis of authentication and payment services, Capacity planning methodologies, Performance models for e-business sites, Modelling web-server workload.

Module-IV **(08 Hours)**

Prerequisite: None Managing Business in the Digital World: Introduction, How IT has changed the concepts of traditional MIS with examples and case studies. Basic understanding of e-business building blocks, Emerging e-Business models, B2B, B2C, C2C etc., Case-studies on e-auctions, electronic markets, electronic procurement, automated supply chains, e marketing, e-customer relationship management, e-finance systems, and negotiations support systems.

TEXT BOOK(S):

1. Scaling for E-Business: Technologies, Models, Performance, and Capacity Planning, Daniel A. Menasc, Virgilio A. F. Almeida, Prentice Hall
2. Management Information Systems- Managing Information Technology in E Business Enterprises, James A. Brien, TMH
3. Forbat, John, “Entrepreneurship” New Age International.
4. Havinal, Veerbhadrappa, “Management and

REFERENCE(S):

1. Auction Theory, Vijay Krishna, Academic Press
2. Entrepreneurship” New Age International
3. Joseph, L. Massod, “Essential of Management", Prentice Hall of India.

OCE301	Waste to Energy	3-0-0	Credits 3

Introduction to energy from waste: characterisation and classification of waste as fuel – agro based, forest residues, industrial waste, Municipal solid waste. Waste to energy options: combustion (unprocessed and processed fuel), gasification, anaerobic digestion, fermentation, pyrolysis. Conversion devices: combustors

(Spreader Stokes, Moving grate type, fluidized bed), gassifier, digesters. Briqueting technology: Production of RDF and briquetted fuel. Properties of fuels derived from waste to energy technology: Producer gas, Biogas, Ethanol and Briquettes, Comparison of properties with conventional fuels. Power generation using waste to energy technologies: Cl and Sl engines. IGCC and IPCC concepts. Landfills: Gas generation and collection in landfills, Introduction to transfer stations. Comparison with non-energy options like Vermiculture, Composting

Text / Reference Books:

1. M.M. EL-Halwagi, Biogas Technology- Transfer and diffusion, Elsevier Applied science Publisher, New York, 1984.

OCE302	Cost Management of Engineering Projects	3-0-0	Credits 3

Introduction and Overview of the Strategic Cost Management Process.
Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunitycost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operationalcontrol; Provision of data for Decision-Making.

Project: meaning, Different types, why to manage, cost overruns centres, various stages of projectexecution: conception to commissioning. Project execution as conglomeration of technical and non-technical activities.Detailed Engineering activities. Pre project execution main clearances anddocuments Project team: Role of each member. Importance Project site: Data required withsignificance. Project contracts.Types and contents. Project execution Project cost control. Bar chartsand Network diagram. Project commissioning: mechanical and process

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints.

Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis.Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

Text / Reference Books:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

OMT301	Composite Materials	3-0-0	Credits 3

Module I **(14 Hours)**

Introduction: definitions and classifications; natural composites; role of matrix andreinforcement; factors which determine properties; the benefits of composites.

Reinforcements and the reinforcement matrix interface: natural fibers; synthetic organicfibers – aramid, polyethylene; and synthetic inorganic fibers – glass, alumina, boron,carbon, silicon based fibers; particulate and whisker reinforcements, reinforcement-matrixinterface – wettability, interfacial bonding, methods for measuring bond strength.

Metal matrix composites: Introduction, important metallic matrices; metal matrixcomposite processing: solid state processing – diffusion bonding, powder metallurgy;liquid state processing – melt stirring, compo casting (rheocasting), squeeze casting, liquid infiltration under gas pressure; deposition – spray co-deposition and other depositiontechniques like CVD and PVD; in situ processes. Interface reactions. Properties of MMCs – physical properties; mechanical properties like elastic properties, room temperaturestrength and ductility, properties at elevated temperatures, fatigue resistance.Processing,structure of multifilamentary superconductors, properties of aluminium reinforced withsilicon carbide particles.

Module II **(14 Hours)**

Ceramic matrix composites: Introduction; processing and structure of monolithic materials– technical ceramics, glass-ceramics. Processing of ceramics: conventional mixing andpressing – cold pressing and sintering, hot pressing, reaction bonding processes,techniques involving slurries, liquid state processing – matrix transfer moulding, liquidinfiltration, sol-gel processing, vapour deposition techniques like CVD, CVI, liquid phase sintering, lanxide process and in situ processes. Processing, properties and applications ofalumina matrix composites - SiC whisker reinforced, zirconia toughened alumina; Glassceramicmatrix composites; Carbon-carbon composites - porous carbon-carboncomposites, dense carbon-carbon composites.

Polymer matrix composites: Introduction; polymer matrices – thermosetting, thermoplastic, rubbers. Processing of PMCs: Hand methods – hand lay-up, spray-upmethods; Moulding methods – matched die moulding, bag moulding processes (autoclavemoulding), resin transfer moulding, pultrusion; Filament winding; Injection moulding.Processing, properties and applications of fibre-reinforced epoxies, PEEK matrix composites, rubber matrix composites. Damping characteristics. Environmental effects in polymer matrix composites. Recycling of PMCs.

Module III **(14 Hours)**

Sandwich structures, foam core type arrangements; Honey comb structures.

Micromechanics of unidirectional composites: micromechanics models for stiffness –longitudinal stiffness, transverse stiffness, shear modulus, poisson's ratio.

Micromechanics models for strength – longitudinal tensile strength, longitudinal compressive strength, transverse tensile strength, transverse compressive strength, in plane shear failure, thermaland moisture effects.

Short fibre composites: reasons for using short fibre composites, fibre length, fibreorientation, stress and strain distribution at fibres, critical fibre length and average fibrestress, stiffness and strength: stiffness of aligned systems, non-aligned systems andvariable fibre orientation, strength of aligned systems, 2-D composites, variable fibreorientation.

Toughening mechanisms in composite materials: crack bowing, crack deflection,debonding, pull-out, wake toughening, microcrack toughening, transformation toughening.

Books for reference:

1. Composite Materials: Engineering and Science, by Matthews and Rawlings, CRC Press.
2. Composite Materials Science and Engineering, K.K.Chawla, Springer.
3. An Introduction to composite material, by D.Hull and T.W. Clyne, Cambridge Universitypress.
4. Metal Matrix Composites, Thermo mechanical Behaviour by M.Taya, and R.J.Arsenault,Pergamon Press, Oxford.
5. Fundamentals of Metal Matrix Composites by S.Suresh, A.Martensen, and A.Needleman,Butterworth, Heinemann

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.

OCE303	Project Engineering and Management	3-0-0	Credits 3

Module-I **(11 Hours)**

Project Management: Project planning, scheduling, controlling, Role of decision in project management, Techniques for analysing alternatives, Methods of planning and programing

Bar charts and milestone charts: Development of bar charts, shortcomings and remedial measures, milestone charts, Development of PERT Network, illustrative problems

Elements of network: Event, activity, dummy, network rules, graphical guidelines for networks, common partial situations, numbering of events, illustrative problems.

Module-II (09 Hours)

Development of network: Planning for network construction, Modes of network construction, steps in development of network, Work breakdown structure, hierarchies

PERT time estimates: Uncertainty- use of PERT, time estimates, frequency distribution, Mean, variance, standard deviation, probability distribution, beta distribution, expected time, illustrative problems

PERT time computations: Earliest expected time, latest allowable occurrence time, Combined tabular computation for T_E and T_L, illustrative problems.

Module-III (12 Hours)

PERT network analysis: Slack, critical path, Probability of meeting scheduled completion time, illustrative problems

CPM network analysis: CPM process, CPM network, activity time estimates, earliest event time, latest allowable occurrence time, combined tabular computation for T_E and T_L, start and finish time of activity, float, critical activity and critical path, illustrative problems.

Module-IV (10 Hours)

CPM cost model: project cost, indirect project cost, direct project cost, slope of direct cost curve, total project cost and optimum duration, contracting the network for cost optimization, steps in time cost optimization

CPM updating: Process, data required for updating, steps in updating process, when to update, illustrative examples.

Books for Reference:

1. Project Planning and Control with PERT and CPM · B C Punmia, Jain Book Depot.
2. Project Management Demystified, Kemp Syd, TMH.
3. Pert and CPM, L Srinath

Course Outcomes:

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

1. Have sound Knowledge of different aspects of Project management.
2. Effectively utilize PERT and CPM Network analysis methods to minimize the time and cost of projects.
3. Make updating and cost crashing.