

E.G.S. PILLAY ENGINEERING COLLEGE (Autonomous)

Approved by AICTE, New Delhi | Affiliated to Anna University, Chennai Accredited by NAAC
with 'A' Grade | Accredited by NBA

NAGAPATTINAM – 611002



M.E. MANUFACTURING ENGINEERING

REGULATION -2021

Second Year – Third Semester

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.		Program Elective – V	PEC	3	0	0	3	3
2.		Open Elective	OEC	3	0	0	3	3
PRACTICALS								
3.	2104MF301	Project Work – Phase I	EEC	0	0	20	20	10
TOTAL				6	0	20	26	16

SEMESTER III, ELECTIVE – V

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	2103MF017	Surface Engineering and Coatings	PEC	3	0	0	3	3
2.	2103MF018	Solid Freeform Manufacturing	PEC	3	0	0	3	3
3.	2103MF019	Advanced Casting Technology	PEC	3	0	0	3	3
4.	2103MF020	Advanced Optimization Techniques	PEC	3	0	0	3	3

OPEN ELECTIVE COURSES [OEC]

(Out of 6 Courses one Course must be selected)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	2103MF021	Business Data Analytics	OEC	3	0	0	3	3
2.	2103MF022	Industrial Safety	OEC	3	0	0	3	3
3.	2103MF023	Operations Research	OEC	3	0	0	3	3
4.	2103MF024	Cost Management of Engineering Projects	OEC	3	0	0	3	3
5.	2103MF025	Composite Materials	OEC	3	0	0	3	3
6.	2103MF026	Waste to Energy	OEC	3	0	0	3	3

2103MF017

SURFACE ENGINEERING AND COATINGS

L T P C
3 0 0 3

OBJECTIVES:

- To impart knowledge on friction.
- To understand wear and measurement methods.
- To understand corrosion and combating methods.
- To learn various techniques to cure corrosion, wear and friction using surface treatments.
- To familiarize the real friction, wear and corrosion combating methods.

MODULE I FRICTION

7

Topography of Surfaces – Surface features – Properties and measurement – Surface interaction – Adhesive Theory of Sliding Friction – Rolling Friction – Friction properties of metallic and non-metallic materials – Friction in extreme conditions – Thermal considerations in sliding contact

MODULE II WEAR

6

Introduction – Abrasive wear, Erosive, Cavitation, Adhesion, Fatigue wear and Fretting Wear- Laws of wear – Theoretical wear models – Wear of metals and non metals - International standards in friction and wear measurements

MODULE III CORROSION

10

Introduction – Principle of corrosion – Classification of corrosion – Types of corrosion – Factors influencing corrosion – Testing of corrosion – In-service monitoring, Simulated service, Laboratory testing – Evaluation of corrosion – Prevention of Corrosion – Material selection, Alteration of environment, Design, Cathodic and Anodic Protection, Corrosion inhibitors

MODULE IV SURFACE TREATMENTS

12

Introduction – Surface properties, Superficial layer – Changing surface metallurgy – Wear resistant coatings and Surface treatments – Techniques – PVD – CVD – Physical CVD – Ion implantation – Surface welding – Thermal spraying – Laser surface hardening and alloying, Applications of coatings and surface treatments in wear and friction control – Characteristics of Wear resistant coatings – New trends in coating technology – DLC – CNC – Thick coatings – Nano-engineered coatings – Other coatings, Corrosion resistant coatings

MODULE V CASE STUDIES ON TRIBOLOGY AND CORROSION

10

Bio-fouling, Tribology and corrosion applicable in biomedical implants, Nano Tribology –electronic devices, hot corrosion in power plants – corrosion in nuclear industry –Machining through controlled Wear and corrosion.

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to

- CO1 :** Understand the surface engineering and surface modification methods that will come in handy to solve the industrial problems.
- CO2 :** Examining related to various materials failure due to friction, wear and corrosion.
- CO3 :** Predicting the surface problems and select a suitable surface treatment.
- CO4 :** Integrating case studies in various applications related to surface engineering.
- CO5 :** Learn various process and techniques developed for surface treatment.

REFERENCES:

1. Basu S K, Sengupta S N and Ahuja B.B, Fundamentals of Tribology, Prentice –Hall of India PvtLtd , New Delhi, 1stEdition, 2010.
2. Halling J (Editor), “Principles of Tribology“, Macmillian – 1991.
3. Rabinowicz E, “Friction and Wear of materials”, John Willey and Sons, UK, 2013.
4. Stachowiak G W and Batchelor A W , “Engineering Tribology”, Butterworth-Heinemann, UK, 4thedition 2014.
5. Williams J.A, “Engineering Tribology”, Oxford Univ. Press, 2005.

2103MF018 -

SOLID FREEFORM MANUFACTURING

L T P C
3 0 0 3

OBJECTIVES:

- To acquaint the students with evolution of Solid Freeform Manufacturing (SFM) / Additive Manufacturing (AM), proliferation into various fields and its effects on supply chain.
- To gain knowledge on Design for Additive Manufacturing (DFAM) and its importance in quality improvement of fabricated parts.
- To acquaint with polymerization and sheet lamination processes and their applications.
- To acquaint with material extrusion and powder bed fusion processes.
- To gain knowledge on jetting and direct energy deposition processes and their applications.

MODULE I INTRODUCTION

9

Need - Development of SFM systems – Hierarchical structure of SFM - SFM process chain – Classification – Applications. Case studies: Bio printing- Food Printing- Electronics printing – Rapid Tooling - Building printing. AM Supply chain. Economics aspect: Strategic aspect- Operative aspect.

MODULE II DESIGN FOR ADDITIVE MANUFACTURING

9

Concepts and Objectives - AM Unique Capabilities - Part Consolidation - Topology Optimization - Lightweight Structures - DFAM for Part Quality Improvement - CAD Modeling - Model Reconstruction - Data Processing for AM - Data Formats - Data Interfacing - Part Orientation - Support Structure Design and Support Structure Generation - Model Slicing - Tool Path Generation. Design Requirements of Additive Manufacturing: For Part Production, For Mass Production, For Series Production. Case Studies.

MODULE III VAT POLYMERIZATION AND SHEET LAMINATION PROCESSES

9

Stereolithography Apparatus (SLA): Principles – Photo Polymerization of SL Resins - Pre Build Process – Part-Building and Post-Build Processes - Part Quality and Process Planning, Recoating Issues - Materials - Advantages - Limitations and Applications. Digital Light Processing (DLP) - Materials - Process - Advantages and Applications.

Laminated Object Manufacturing (LOM): Working Principles - Process - Materials, Advantages, Limitations and Applications. Ultrasonic Additive Manufacturing (UAM) - Process - Parameters - Applications. Case Studies.

MODULE IV MATERIAL EXTRUSION AND POWDER BED FUSION PROCESSES

9

Fused deposition Modeling (FDM): Working Principles - Process - Materials and Applications. Design Rules for FDM.

Selective Laser Sintering (SLS): Principles - Process - Indirect and Direct SLS - Powder Structure – Materials - Surface Deviation and Accuracy - Applications. Multijet Fusion.

Selective Laser Melting (SLM) and Electron Beam Melting (EBM): Principles – Processes – Materials – Advantages - Limitations and Applications. Case Studies.

MODULE V JETTING AND DIRECT ENERGY DEPOSITION PROCESSES

9

Binder Jetting: Three dimensional Printing (3DP): Principles – Process - Physics of 3DP - Types of printing: Continuous mode – Drop on Demand mode - Process – Materials - Advantages - Limitations - Applications.

Material Jetting: Multi Jet Modelling (MJM) - Principles - Process - Materials - Advantages and Limitations.

Laser Engineered Net Shaping (LENS): Processes- Materials- Advantages - Limitations and Applications. Case Studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students shall be able to:

- CO1: Recognize the importance in the evolution of SFM/AM, proliferation into the various fields and its effects on supply chain.
- CO2: Evaluate the design for AM and its importance in the quality of fabricated parts.
- CO3: Acquire knowledge on principles and applications of polymerization and sheet lamination processes with case studies.
- CO4: Acquire knowledge on principles of material extrusion and powder bed fusion processes and design guidelines.
- CO5: Perceive jetting and direct energy deposition processes and their applications.

REFERENCES:

1. Andreas Gebhardt and Jan-Steffen Hotter, “Additive Manufacturing: 3D Printing for Prototyping and Manufacturing”, Hanser publications Munchen, Germany, 2015. ISBN: 978-1-56990-582- 1.
2. Ben Redwood, Brian Garret, Filemon Schöffner, and Tony Fadel, “The 3D Printing Handbook: Technologies, Design and Applications”, 3D Hubs B.V., Netherland, 2017. ISBN-13: 978- 9082748505.
3. Ian Gibson, David W. Rosen and Brent Stucker, “Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing” Springer - New York, USA, 2nd Edition, 2015. ISBN-13: 978-1493921126.
4. Liou, L.W. and Liou, F.W., “Rapid Prototyping and Engineering applications: A tool box for prototype development”, CRC Press, 1st Edition, 2007 FL, USA. ISBN- 9780849334092.
5. Milan Brandt., “Laser Additive Manufacturing 1st Edition Materials, Design, Technologies, and Applications”, Woodhead Publishing, UK, 2016. ISBN- 9780081004333.

2103MF019

ADVANCED CASTING TECHNOLOGY

L T P C

3 0 0 3

OBJECTIVES:

- To gain the knowledge about principles of foundry
- To gain the knowledge about principles of casting technology
- To gain the knowledge about principles of Moulding technology.
- To familiarize the casting of ferrous and non ferrous alloys
- To know the advanced casting technology.

MODULE I PATTERN MAKING, MOULDING AND CORE MAKING

9

Pattern materials-Pattern allowances-Pattern layout, pattern making – Moulding sands – Ingredients – Specification and testing of moulding sands – classification of moulding sands –Sand conditioning – Characteristics of cores and core sands – types of cores

MODULE II SOLIDIFICATION AND GATING

9

Solidification principles – planar and dendritic solidification – constitutional super cooling - Freezing of a pure metal –Freezing of alloys – Properties related to freezing mechanism- Directional solidification – progressive solidification - Gates and risers-their functions – types-design principles, design of gating and riser - illustrative problems in riser and gating design-

MODULE III MOULDING METHODS AND QUALITY CONTROL

9

Green sand moulding-dry sand moulding-CO₂ moulding-no bake moulding- shell moulding, investment casting- permanent moulding-die casting - centrifugal casting-continuous casting- Defects in casting – Inspection and testing of castings – fettling and heat treatment of castings

MODULE IV CASTING OF FERROUS AND NON FERROUS ALLOYS

9

Melting equipment for foundries – Types of furnaces – Refractories for melting MODULEs -Casting of Aluminium, Magnesium, Copper and their alloys – Casting of steel, cast iron and gray iron

MODULE V ADVANCES IN CASTING

9

Rheocasting - Thixo casting - magnetic moulding - Impulse moulding- high pressure moulding – Stir casting - Squeeze casting – Application of ultrasonic cavitations to develop composites - mechanization and automation of foundries –Application of computers in foundries- product design and analysis- casting design and simulation – software packages for foundry use- pollution control in foundries – energy saving in foundries.

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to

- CO1** : Imply the techniques to make the pattern, core and moulding.
CO2 : Evaluate the process parameters involved in casting processes.
CO3 : Identify the appropriate casting techniques for various materials.
CO4 : Know about various equipments and furnaces used in casting process.
CO5 : Grasp the significance of advanced casting process and its applications.

REFERENCES

1. ASM Metals Hand Book, Vol 15, "Casting" ASM International, 9th Edition, 2008.
2. Beeley P R, "Foundry Technology", Butterworths, London, 2nd Edition, 2001.
3. Heine R W, Loper C R, Rosenthal P C "Principles of Metal Casting", Tata McGraw Hill, New Delhi, 2012.
4. Jain P L, "Principles of Foundry Technology", Tata McGraw Hill, New Delhi, 5th Edition, 2007.
5. Ramana Rao T V, "Metal Casting: Principles and Practice", New Age International Publishers, New Delhi, 2006.
6. Srinivasan N K, "Foundry Engineering", Khanna Tech Publishers, New Delhi, 1994.

2103MF020

ADVANCED OPTIMIZATION TECHNIQUES

L T P C
3 0 0 3

OBJECTIVES:

- Learn to solve integer programming problems
- To know how to solve the Dynamic programming problems
- Learn to solve non – linear programming problems with un constrained optimization problems
- Understand to solve non-linear programming problems using KKT conditions, quadratic and separable programming
- To create awareness of Meta heuristic algorithms.

MODULE I INTEGER PROGRAMMING

9

Branch and Bound technique –cutting plane algorithm method - Travelling Salesman problem - Traveling Salesman Problem - Branch and Bound Algorithms for TSP - Heuristics for TSP - Chinese Postman Problem - Vehicle Routing Problem

MODULE II DYNAMIC PROGRAMMING

9

Characteristics of Dynamic Programming Problems - Deterministic Dynamic Programming - Forward and Backward recursive recursion – selected dynamic programming application – investment model – inventory model – replacement model –reliability model – stage coach problem.

MODULE III NONLINEAR PROGRAMMING - I:

9

Types of Nonlinear Programming Problems - One-Variable Unconstrained Optimization - Multivariable Unconstrained Optimization -

MODULE IV NONLINEAR PROGRAMMING – II:

9

The Karush-Kuhn-Tucker (KKT) Conditions for Constrained Optimization - Quadratic Programming - Separable Programming - Convex Programming - Nonconvex Programming

MODULE V NON-TRADITIONAL OPTIMIZATION

9

Overview of Genetic algorithms, Simulated Annealing, neural network based optimization. Particle Swarm optimization, Ant Colony Optimization, Optimization of Fuzzy Systems.

TOTAL: 45 PERIODS

OUTCOMES:

CO1: Know how to solve integer programming problems

CO2: Able to solve Dynamic programming problems

CO3: Familiar in solving unconstrained non linear optimization problems

CO4: Familiar in solving constrained linear optimization problems

CO5: Know how to solve non linear optimization problems using Meta heuristic algorithms

REFERENCES:

1. Fredrick S.Hillier and G.J.Liberman, “Introduction to Operations Research”, McGraw Hill Inc.1995.
2. Kalymanoy Deb, “Optimization for Engineering Design”, PHI, 2003
3. Christos H. Papadimitriou, Kenneth Steiglitz, Combinatorial Optimization, PHI 2006
4. Ravindran – Phillips –Solberg, “Operations Research – Principles and Practice”, John Wiley India, 2006.
5. Singiresu S.Rao, “Engineering optimization – Theory and practices”, John Wiley and Sons,1996.

OPEN ELECTIVE COURSES (OEC)

2103MF021

BUSINESS DATA ANALYTICS

L T P C
3 0 0 3

COURSE OBJECTIVES:

- To understand the basics of business analytics and its life cycle.
- To gain knowledge about fundamental business analytics.
- To learn modeling for uncertainty and statistical inference.
- To understand analytics using Hadoop and Map Reduce frameworks.
- To acquire insight on other analytical frameworks.

MODULE I OVERVIEW OF BUSINESS ANALYTICS

9

Introduction – Drivers for Business Analytics – Applications of Business Analytics: Marketing and Sales, Human Resource, Healthcare, Product Design, Service Design, Customer Service and Support – Skills Required for a Business Analyst – Framework for Business Analytics Life Cycle for Business Analytics Process.

Suggested Activities:

- Case studies on applications involving business analytics.
- Converting real time decision making problems into hypothesis.
- Group discussion on entrepreneurial opportMODULEies in Business Analytics.

Suggested Evaluation Methods:

- Assignment on business scenario and business analytical life cycle process.
- Group presentation on big data applications with societal need.
- Quiz on case studies.

MODULE II ESSENTIALS OF BUSINESS ANALYTICS

9

Descriptive Statistics – Using Data – Types of Data – Data Distribution Metrics: Frequency, Mean, Median, Mode, Range, Variance, Standard Deviation, Percentile, Quartile, z-Score, Covariance, Correlation – Data Visualization: Tables, Charts, Line Charts, Bar and Column Chart, Bubble Chart, Heat Map – Data Dashboards.

Suggested Activities:

- Solve numerical problems on basic statistics.
- Explore chart wizard in MS Excel Case using sample real time data for data visualization.
- Use R tool for data visualization.

Suggested Evaluation Methods:

- Assignment on descriptive analytics using benchmark data.
- Quiz on data visualization for univariate, bivariate data.

MODULE III MODELING UNCERTAINTY AND STATISTICAL INFERENCE

9

Modeling Uncertainty: Events and Probabilities – Conditional Probability – Random Variables – Discrete Probability Distributions – Continuous Probability Distribution – Statistical Inference: Data Sampling – Selecting a Sample – Point Estimation – Sampling Distributions – Interval Estimation – Hypothesis Testing.

Suggested Activities:

- Solving numerical problems in sampling, probability, probability distributions and hypothesis testing.
- Converting real time decision making problems into hypothesis.

Suggested Evaluation Methods:

- Assignments on hypothesis testing.
- Group presentation on real time applications involving data sampling and hypothesis testing.
- Quizzes on topics like sampling and probability.

MODULE IV ANALYTICS USING HADOOP AND MAPREDUCE FRAMEWORK 9

Introducing Hadoop – RDBMS versus Hadoop – Hadoop Overview – HDFS (Hadoop Distributed File System) – Processing Data with Hadoop – Introduction to MapReduce – Features of MapReduce – Algorithms Using Map-Reduce: Matrix-Vector Multiplication, Relational Algebra Operations, Grouping and Aggregation – Extensions to MapReduce.

Suggested Activities:

- Practical – Install and configure Hadoop.
- Practical – Use web based tools to monitor Hadoop setup.
- Practical – Design and develop MapReduce tasks for word count, searching involving textcorpus etc.

Suggested Evaluation Methods:

- Evaluation of the practical implementations.
- Quizzes on topics like HDFS and extensions to MapReduce.

MODULE V OTHER DATA ANALYTICAL FRAMEWORKS 9

Overview of Application development Languages for Hadoop – PigLatin – Hive – Hive Query Language (HQL) – Introduction to Pentaho, JAQL – Introduction to Apache: Sqoop, Drill and Spark, Cloudera Impala – Introduction to NoSQL Databases – Hbase and MongoDB.

Suggested Activities:

- Practical – Installation of NoSQL database like MongoDB.
- Practical – Demonstration on Sharding in MongoDB.
- Practical – Install and run Pig
- Practical – Write PigLatin scripts to sort, group, join, project, and filter data.
- Design and develop algorithms to be executed in MapReduce involving numerical methods for analytics.

Suggested Evaluation Methods:

- Mini Project (Group) – Real time data collection, saving in NoSQL, implement analytical techniques using Map-Reduce Tasks and Result Projection.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of the course, the student will be able to:

- Identify the real world business problems and model with analytical solutions.
- Solve analytical problem with relevant mathematics background knowledge.
- Convert any real world decision making problem to hypothesis and apply suitable statistical testing.
- Write and Demonstrate simple applications involving analytics using Hadoop and MapReduce
- Use open source frameworks for modeling and storing data.
- Apply suitable visualization technique using R for visualizing voluminous data.

REFERENCES:

1. Vignesh Prajapati, “Big Data Analytics with R and Hadoop”, Packt Publishing, 2013.
2. Umesh R Hodeghatta, Umesha Nayak, “Business Analytics Using R – A Practical Approach”, Apress, 2017.
3. Anand Rajaraman, Jeffrey David Ullman, “Mining of Massive Datasets”, Cambridge University Press, 2012.
4. Jeffrey D. Camm, James J. Cochran, Michael J. Fry, Jeffrey W. Ohlmann, David R. Anderson, “Essentials of Business Analytics”, Cengage Learning, second Edition, 2016.
5. U. Dinesh Kumar, “Business Analytics: The Science of Data-Driven Decision Making”, Wiley, 2017.
6. A. Ohri, “R for Business Analytics”, Springer, 2012
7. Rui Miguel Forte, “Mastering Predictive Analytics with R”, Packt Publication, 2015.

2103MF022

INDUSTRIAL SAFETY

L T P C
3 0 0 3

COURSE OBJECTIVES:

- Summarize basics of industrial safety
- Describe fundamentals of maintenance engineering
- Explain wear and corrosion
- Illustrate fault tracing
- Identify preventive and periodic maintenance

MODULE I INTRODUCTION

9

Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

MODULE II FUNDAMENTALS OF MAINTENANCE ENGINEERING

9

Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

MODULE III WEAR AND CORROSION AND THEIR PREVENTION

9

Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

MODULE IV FAULT TRACING

9

Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

MODULE V PERIODIC AND PREVENTIVE MAINTENANCE

9

Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- CO1: Ability to summarize basics of industrial safety
- CO2: Ability to describe fundamentals of maintenance engineering
- CO3: Ability to explain wear and corrosion
- CO4: Ability to illustrate fault tracing
- CO5: Ability to identify preventive and periodic maintenance

REFERENCES:

1. Audels, Pump-hydraulic Compressors, Mcgrew Hill Publication, 1978.
2. Garg H P, Maintenance Engineering, S. Chand and Company, 1987.
3. Hans F. Winterkorn , Foundation Engineering Handbook, Chapman & Hall London, 2013.
4. Higgins & Morrow , Maintenance Engineering Handbook, Eighth Edition, 2008

2103MF023

OPERATIONS RESEARCH

L T P C
3 0 0 3

COURSE OBJECTIVES:

- Solve linear programming problem and solve using graphical method.
- Solve LPP using simplex method
- Solve transportation , assignment problems
- Solve project management problems
- Solve scheduling problems

MODULE I	LINEAR PROGRAMMING	9
Introduction to Operations Research – assumptions of linear programming problems - Formulation of linear programming problem – Graphical method		
MODULE II	ADVANCES IN LINEAR PROGRAMMING	9
Solutions to LPP using simplex algorithm- Revised simplex method - primal dual relationships –Dual simplex algorithm - Sensitivity analysis		
MODULE III	NETWORK ANALYSIS – I	9
Transportation problems -Northwest corner rule, least cost method, Voges’s approximation method - Assignment problem -Hungarian algorithm		
MODULE IV	NETWORK ANALYSIS – II	9
Shortest path problem: Dijkstra’s algorithms, Floyds algorithm, systematic method -CPM/PERT		
MODULE V	NETWORK ANALYSIS – III	9
Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models		
		TOTAL : 45 PERIODS

COURSE OUTCOMES:

- CO1: To formulate linear programming problem and solve using graphical method.
- CO2: To solve LPP using simplex method
- CO3: To formulate and solve transportation, assignment problems
- CO4: To solve project management problems
- CO5: To solve scheduling problems

REFERENCES:

1. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010
2. Hitler Libermann, Operations Research: McGraw Hill Pub. 2009
3. Pant J C, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Pannerselvam, Operations Research: Prentice Hall of India 2010
5. Taha H A, Operations Research, An Introduction, PHI, 2008

2103MF024 COST MANAGEMENT OF ENGINEERING PROJECTS

L T P C
3 0 0 3

OBJECTIVES:

- Summarize the costing concepts and their role in decision making
- Infer the project management concepts and their various aspects in selection
- Interpret costing concepts with project execution
- Develop knowledge of costing techniques in service sector and various budgetary control techniques
- Illustrate with quantitative techniques in cost management

MODULE I INTRODUCTION TO COSTING CONCEPTS 9
Objectives of a Costing System; Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost; Creation of a Database for operational control.

MODULE II INTRODUCTION TO PROJECT MANAGEMENT 9
Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities, Detailed Engineering activities, Pre project execution main clearances and documents, Project team: Role of each member, Importance Project site: Data required with significance, Project contracts.

MODULE III PROJECT EXECUTION AND COSTING CONCEPTS 9
Project execution Project cost control, Bar charts and 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, Pricing strategies: Pareto Analysis, Target costing, Life Cycle Costing.

MODULE IV COSTING OF SERVICE SECTOR AND BUDGETERY CONTROL 9
Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Activity- Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis, Budgetary Control: Flexible Budgets; Performance budgets; Zero-based budgets.

MODULE V QUANTITATIVE TECHNIQUES FOR COST MANAGEMENT 9
Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Learning Curve Theory.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- CO1 – Understand the costing concepts and their role in decision making
- CO2–Understand the project management concepts and their various aspects in selection
- CO3–Interpret costing concepts with project execution
- CO4–Gain knowledge of costing techniques in service sector and various budgetary control techniques
- CO5 - Become familiar with quantitative techniques in cost management

REFERENCES:

1. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher, 1991
2. Charles T. Horngren and George Foster, Advanced Management Accounting, 1988
3. Charles T. Horngren et al Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi, 2011
4. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting, 2003
5. Vohra N.D., Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd, 2007

2103MF025

COMPOSITE MATERIALS

L T P C

3 0 0 3

COURSE OBJECTIVES:

- Summarize the characteristics of composite materials and effect of reinforcement in composite materials.
- Identify the various reinforcements used in composite materials.
- Compare the manufacturing process of metal matrix composites.
- Understand the manufacturing processes of polymer matrix composites.
- Analyze the strength of composite materials.

MODULE I INTRODUCTION

9

Definition – Classification and characteristics of Composite materials - Advantages and application of composites - Functional requirements of reinforcement and matrix - Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

MODULE II REINFORCEMENTS

9

Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers - Properties and applications of whiskers, particle reinforcements - Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures - Isostrain and Isostress conditions.

MODULE III MANUFACTURING OF METAL MATRIX COMPOSITES

9

Casting – Solid State diffusion technique - Cladding – Hot isostatic pressing - Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving - Properties and applications.

MODULE IV MANUFACTURING OF POLYMER MATRIX COMPOSITES

9

Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding - Properties and applications.

MODULE V STRENGTH

9

Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first ply failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- CO1 - Know the characteristics of composite materials and effect of reinforcement in composite materials.
- CO2 – Know the various reinforcements used in composite materials.
- CO3 – Understand the manufacturing processes of metal matrix composites.
- CO4 – Understand the manufacturing processes of polymer matrix composites.
- CO5 – Analyze the strength of composite materials.

REFERENCES:

1. Cahn R.W. - Material Science and Technology – Vol 13 – Composites, VCH, West Germany.
2. Callister, W.D Jr., Adapted by Balasubramaniam R, Materials Science and Engineering, An introduction, John Wiley & Sons, NY, Indian edition, 2007.
3. Chawla K.K., Composite Materials, 2013.
4. Lubin.G, Hand Book of Composite Materials, 2013.

2103MF026

WASTE TO ENERGY

L T P C

3 0 0 3

OBJECTIVES:

- Interpret the various types of wastes from which energy can be generated
- Develop knowledge on biomass pyrolysis process and its applications
- Develop knowledge on various types of biomass gasifiers and their operations
- Invent knowledge on biomass combustors and its applications on generating energy
- Summarize the principles of bio-energy systems and their features

MODULE I INTRODUCTION TO EXTRACTION OF ENERGY FROM WASTE 9

Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

MODULE II BIOMASS PYROLYSIS 9

Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

MODULE III BIOMASS GASIFICATION 9

Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

MODULE IV BIOMASS COMBUSTION 9

Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

MODULE V BIO ENERGY 9

Properties of biogas (Calorific value and composition), Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production -Urban waste to energy conversion - Biomass energy programme in India.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- CO1 – Understand the various types of wastes from which energy can be generated
- CO2 – Gain knowledge on biomass pyrolysis process and its applications
- CO3 – Develop knowledge on various types of biomass gasifiers and their operations
- CO4 – Gain knowledge on biomass combustors and its applications on generating energy
- CO5 – Understand the principles of bio-energy systems and their features

REFERENCES:

1. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
2. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.

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Project Work – Phase I

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OBJECTIVES:

- To enable students to select and define a problem/need for analysis in the field of manufacturing engineering.
- To review and analyse literature/ data of selected problem for study and propose objective and scope of dissertation work.
- To develop hypothesis and identify methodology based on ethical, scientific and systematic application of knowledge in the field of problem
- To design, model and experiment/develop optimal solution for problem being investigated
- To analysis and interpretation of data, and synthesis of the information to provide valid conclusions and submit dissertation.

EVALUATION:

- A project topic may be selected based on the literature survey and the creative ideas of the students themselves in consultation with their project supervisor. The topic should be so chosen that it will improve and develop the skills to design, fabricate, analyse, test and research. Literature survey and a part of the project work be carried out in dissertation I.
- The project work is evaluated jointly by external and internal examiners constituted by the Head of the Department based on oral presentation and the project report.
- A project report for dissertation I is to be submitted at the end.
- Project work evaluation is based on the Regulations of the Credit system for the Post graduate programmes of EGSPEC.

TOTAL: 90 PERIODS

OUTCOMES:

CO1 : The students would apply the knowledge gained from theoretical and practical courses in solving problems, so as to give confidence to the students to be creative and get trained in planning, organizing and coordination various components of dissertation work.