PAAVAI ENGINEERING COLLEGE, NAMAKKAL – 637018
(AUTONOMOUS)
REGULATIONS 2019
CHOICE BASED CREDIT SYSTEM
M.E. – ENGINEERING DESIGN

CURRICULUM

(Applicable to the candidates admitted during the academic year 2021-2022 onwards)

SEMESTER I

S. No	Category	Course Code	Course Title	L	T	P	C
Theory							
1	PC	PED19101	Advanced Stress Analysis	3	0	0	3
2	PC	PED19102	Advanced Vibrations and Acoustics	3	1	0	4
3	PC	PED19103	Concepts of Engineering Design	3	0	0	3
4	PC	PED19104	Computer Aided Design	3	0	0	3
5	PE	PED1915*	Professional Elective I	3	0	0	3
6	PE	PED1925*	Professional Elective II	3	0	0	3
7	AC	PEN19171	English For Research Paper Writing (Audit Course I)	2	0	0	0
Practical							
8	PC	PED19105	Computer Aided Design Laboratory	0	0	4	2
			Total	**20**	**1**	**4**	**21**

SEMESTER II

S. No	Category	Course Code	Course Title	L	T	P	C
Theory							
1	PC	PED19201	Finite Element Method	3	0	0	3
2	PC	PEN19201	Research Methodology and IPR	3	0	0	3
3	PE	PED1935*	Professional Elective III	3	0	0	3
4	PE	PED1945*	Professional Elective IV	3	0	0	3
5	AC	PEN19271	Pedagogy Studies (Audit Course II)	2	0	0	0
Practical							
6	PC	PED19202	Simulation and Analysis Laboratory	0	0	4	2
7	EE	PED19203	Mini Project	0	0	4	2
			Total	**14**	**0**	**8**	**16**

SEMESTER III

S. No	Category	Course Code	Course Title	L	T	P	C
Theory							
1	PE	PED1955*	Professional Elective V	3	0	0	3
2	OE	PED1990*	Open Elective	3	0	0	3
Practical							
3	EE	PED19301	Dissertation Phase I	0	0	20	10
			Total	**6**	**0**	**20**	**16**

SEMESTER IV

S. No	Category	Course Code	Course Title	L	T	P	C
Practical							
1	EE	PED19401	Dissertation Phase II	0	0	32	16
			Total	**0**	**0**	**32**	**16**
						Total Credits : 69	

PROFESSIONAL ELECTIVE I

S. No	Category	Course Code	Course Title	L	T	P	C
1	PE	PED19151	Advanced Machine Design	3	0	0	3
2	PE	PED19152	Design for Manufacturing and Assembly	3	0	0	3
3	PE	PMA19153	Mathematical Methods in Engineering	3	0	0	3
4	PE	PED19153	Rapid Prototyping and Tooling	3	0	0	3

PROFESSIONAL ELECTIVE II

S. No	Category	Course Code	Course Title	L	T	P	C
1	PE	PED19251	Advanced Engineering Materials	3	0	0	3
2	PE	PED19252	Mechanics of Composite Materials	3	0	0	3
3	PE	PED19253	Analysis and Synthesis of Mechanisms	3	0	0	3
4	PE	PED19254	Mechatronics in Manufacturing	3	0	0	3

PROFESSIONAL ELECTIVE III

S. No	Category	Course Code	Course Title	L	T	P	C
1	PE	PED19351	Tribology in Design	3	0	0	3
2	PE	PED19352	Robotics	3	0	0	3
3	PE	PED19353	Fracture Mechanics	3	0	0	3
4	PE	PED19354	Reverse Engineering	3	0	0	3

PROFESSIONAL ELECTIVE IV

S. No	Category	Course Code	Course Title	L	T	P	C
1	PE	PED19451	Multi-body Dynamics	3	0	0	3
2	PE	PED19452	Condition Based Monitoring	3	0	0	3
3	PE	PED19453	Optimization Techniques in Design	3	0	0	3
4	PE	PED19454	Design of Hydraulic and Pneumatic systems	3	0	0	3

PROFESSIONAL ELECTIVE V

S. No	Category	Course Code	Course Title	L	T	P	C
1	PE	PED19551	Integrated Manufacturing Systems	3	0	0	3
2	PE	PED19552	Productivity Management and Re-Engineering	3	0	0	3
3	PE	PED19553	Theory of Plates and Shells	3	0	0	3
4	PE	PED19554	Plasticity and Metal Forming	3	0	0	3

OPEN ELECTIVE

S. No	Category	Course Code	Course Title	L	T	P	C
1	OE	PMA19901	Operations Research	3	0	0	3
2	OE	PSE19901	Cost Management of Engineering Projects	3	0	0	3
3	OE	PCE19901	Business Analytics	3	0	0	3
4	OE	PED19901	Industrial Safety	3	0	0	3
5	OE	PED19902	Composite Materials	3	0	0	3
6	OE	PED19903	Waste to Energy	3	0	0	3

SPECIAL ELECTIVES

S. No	Category	Course Code	Course Title	L	T	P	C
1	SPE	PMR1901	Energy Management in Thermal Systems	3	0	0	3
2	SPE	PMR1902	Energy Resources	3	0	0	3
3	SPE	PMR1903	Advanced Power Plant Engineering	3	0	0	3
4	SPE	PMR1904	Energy Conservation in Industrial Utilities	3	0	0	3
5	SPE	PMR1905	Environmental Benefits of Energy Management	3	0	0	3

PED19301 **DISSERTATION PHASE I** **0 0 20 10**

COURSE OBJECTIVES

To enable the students to

- develop the ability to solve a specific problem right from its identification, literature review and analysis till finding a successful solution for the same.
- train the students in preparing project reports and to face reviews and viva-voce examination and develop presentation skills

SYLLABUS

The student works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

COURSE OUTCOMES

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

- take up any challenging practical problems and find solution by formulating proper methodology, using the technical knowledge and professional approach.
- testing, analyse and prepare the report for a given project, write and present technical paper based on the research work.

TOTAL PERIODS: 300

CO - PO Mapping

Mapping of Course Outcomes with Programme Outcomes:

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programme Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	3	-	2	1	2	3	2	1	3	3	3
CO2	3	3	1	3	-	-	1	-	3	-	1	3	3	3
CO3	2	2	2	-	-	2	1	2	2	2	1	3	3	3

PED19401 **DISSERTATION PHASE II** **0 0 32 16**

COURSE OBJECTIVES

To enable the students to

- the project work shall be based on the knowledge acquired by the student during the course and preferably it should meet and contribute towards the needs of the society.
- the project aims to provide an opportunity of designing and building complete system or subsystems based on area where the student likes to acquire specialized skills.

SYLLABUS

In Project Work Phase –II, the student shall complete the balance part of the Project that will consist of fabrication of set up required for the project, conducting experiments and taking results, analysis &validation of results and conclusions. The student shall prepare the final report of Project work in standard format duly certified for satisfactory completion of the work by the concerned guide and head of the department/Institute.

COURSE OUTCOMES

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

- completion of the project work, the students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology.
- apply engineering and management principles through efficient handling of project have a clear idea of his/her area of work and they are in a position to carry out the work in a systematic way

TOTAL PERIODS: 480

CO - PO Mapping

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COs	Programme Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	3	-	2	1	2	3	2	1	3	3	3
CO2	3	3	1	3	-	-	1	-	3	-	1	3	3	3
CO3	2	2	2	-	-	2	1	2	2	2	1	3	3	3
CO4	3	3	1	3	-	-	1	-	3	-	1	3	3	3
CO5	3	3	2	-	-	2	1	2	2	2	1	3	3	3

PAVAI ENGINEERING COLLEGE NAMAKKAL
Approved
BOARD OF STUDIES
Mechanical Engineering
30/6/20
AUTONOMOUS

PROFESSIONAL ELECTIVE V

PED19551 INTEGRATED MANUFACTURING SYSTEMS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- apply the principles of production systems and manufacturing strategies.
- acquire depth knowledge in the concepts of group technologies and process planning techniques.
- familiarize the planning and control concepts in shop floor and data collection systems using computer.
- understand the production monitoring, process control and inspection techniques.
- practice various manufacturing systems, rapid prototyping and artificial intelligence through CIM.

UNITI INTRODUCTION **5**

Objectives of a manufacturing system; identifying business opportunities and problems classification production systems; linking manufacturing strategy and systems analysis of manufacturing operations

UNIT II GROUP TECHNOLOGY AND COMPUTER AIDED PROCESS PLANNING 5

Introduction-part families, parts classification and cooling; group technology- machine cells, benefits of group technology; Process planning function CAPP; Computer generated time standards.

UNIT III COMPUTER AIDED PLANNING AND CONTROL **10**

Production planning and control-cost planning and control, inventory management; Material requirements planning (MRP)-shop floor control, Factory data collection system, Automatic identification system; barcode technology; automated data collection system.

UNIT IV COMPUTER MONITORING **10**

Types of production monitoring systems; structure model of manufacturing process control & strategies- direct digital control; supervisory computer control computer in QC - contact inspection methods, noncontact inspection method, computer-aided testing; integration of CAQC with CAD/CAM.

UNIT V INTEGRATED MANUFACTURING SYSTEM **15**

Definition, application, features, types of manufacturing systems; machine tools materials handling system- computer control system, DNC systems manufacturing cell; Flexible manufacturing systems (FMS) - the FMS concept transfer systems, head changing FMS; variable mission manufacturing system CAD/CAM system; human labor in the manufacturing system; computer integrated manufacturing system benefits; Rapid prototyping; Artificial Intelligence and Expert system in CIM.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- apply manufacturing strategy and analysis in industry.
- implement group technology and computer aided process planning in relevant business opportunities.
- use different techniques in production planning and cost control.
- work on concepts of computer controlling and monitoring systems in manufacturing industry.
- utilize flexible manufacturing systems in production industry.

REFERENCES

1. Groover, M.P., "Automation, Production System and CIM", Prentice-Hall of India,2016.
2. YoremKoren, "Computer Integrated Manufacturing Systems", McGraw Hill, 2004.
3. David Bedworth, "Computer Integrated Design and Manufacturing", TMH, New Delhi, 1998.
4. Ranky, Paul G., "Computer Integrated Manufacturing", Prentice Hall International 1997.

CO - PO Mapping

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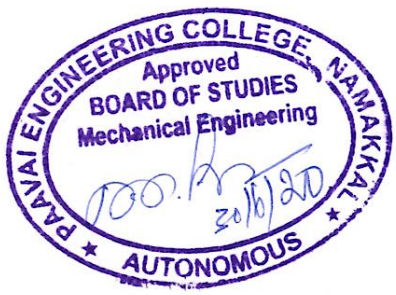
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programme Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	1	2	1	1	1	2	-	-	1	2	2	3	3
CO2	3	1	2	1	1	1	2	-	-	1	2	2	3	3
CO3	3	1	2	1	3	1	2	-	-	1	2	2	3	3
CO4	3	1	2	1	3	1	2	-	-	1	2	2	3	3
CO5	3	1	2	1	2	1	2	-	-	1	2	2	3	3



PED19552 PRODUCTIVITY MANAGEMENT AND RE-ENGINEERING 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the concepts of productivity and analyze its factors and models.
- analyze the concepts of management by objectives (MBO) and performance objective Productivity (POP).
- study the elements of organizational transformation, reengineering principles and models.
- acquire knowledge on reengineering process improvement and its models like LMICIP and NPRDC
- identify reengineering tools, techniques and its implementation.

UNIT I PRODUCTIVITY **9**

Productivity Concepts – Macro and Micro factors of productivity; Dynamics of Productivity – Productivity Cycle, Productivity Measurement at International, National and Organization level, Productivity measurement models.

UNIT II SYSTEMS APPROACH TO PRODUCTIVITY MEASUREMENT **9**

Conceptual frame work; Management by Objectives (MBO); Performance Objectivities Productivity (POP); Methodology and application to manufacturing and service sector

UNIT III ORGANIZATIONAL TRANSFORMATION **9**

Elements of Organizational Transformation and Reengineering-Principles of organizational transformation andre- engineering; fundamentals of process reengineering- preparing the workforce for transformation and re- engineering, methodology, guidelines; LMI CIP Model; DSMC Q & PMP model.

UNIT IV RE-ENGINEERING PROCESS IMPROVEMENT MODELS **9**

PMI models; PASIM Model; Moen and Nolan Strategy for process improvement; LMICIP Model; NPRDC Model.

UNIT V RE-ENGINEERING TOOLS AND IMPLEMENTATION **9**

Analytical and process tools and techniques ; Information and Communication Technology ; Implementation of Reengineering Projects ; Success Factors and common implementation Problem ; Cases.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- distinguish between macro and micro factors of productivity and describe measurement models.

- comprehend the system approach to productivity measurement.
- analyze the process of organizational transformations.
- apply re-engineering process improvement models in manufacturing industry.
- use re-engineering tools ,implementation techniques and analyze the problems involved to give solutions with respect to production industry.

REFERENCES

1. Sumanth, D.J., „Productivity Engineering and Management", TMH, NewDelhi,2007.
2. Micheel Hammer and james champy, Reengineering the corporation – A manifesto for business revolution, Nicholarbarkey publisher, London, 2006.
3. Edosomwan, J.A., "Organisational Transformation and Process Re-engineering", Library Cataloging in Pub. Data, 2001
4. Premvrat, Sardana, G.D. and Sahay, B.S., "Productivity Management – A Systems Approach". Narosa Publishing House. New Delhi, 2001.

CO - PO Mapping

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(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programme Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	1	2	1	1	1	2	-	-	1	2	2	3	3
CO2	3	1	2	1	1	2	2	-	-	1	2	2	3	3
CO3	3	1	2	1	3	1	2	-	-	1	2	2	3	3
CO4	3	1	2	1	3	1	2	-	-	1	2	2	3	3
CO5	3	2	1	1	3	1	1	-	-	2	2	2	3	3

PED19553 **THEORY OF PLATES AND SHELLS** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- acquire thorough knowledge in structural mechanics, approximations of membranes, plates and shells and principles of elasticity.
- apply with the concepts of classical theories, equilibrium in different coordinates, bending of plates.
- analyze buckling analysis of plates under different compressive and boundary conditions.
- evaluate and interpret by various vibrating conditions of plates under different loads conditions.
- examine the shells of revolution and various aspects of cylindrical and spherical shells.

UNIT I GENERAL INTRODUCTION **7**

Review of equations of elasticity- kinematics, compatibility equations, stress measures, equations of motions- constitutive relations; transformation of stresses, strains and stiffness; energy principles and variation methods in elasticity; virtual work-external and internal virtual work; variation operator-functional, Euler Lagrange equations; energy principles- Hamilton's principle, principle of minimum total potential, applications.

UNIT II CLASSICAL THEORY OF PLATES **10**

Plates as structural elements; stress and moment resultants; assumptions made in the classical theory; displacement fields and strains- equations of equilibrium in Cartesian coordinates and in polar coordinates, boundary conditions; bending of rectangular plates with various boundary conditions and loading; symmetrical and asymmetrical bending of circular plates; limitations of classical theory; finite element analysis(elementary treatment only; discussion of various elements used and their capabilities- not for examination)

UNIT III BUCKLING ANALYSIS OF RECTANGULAR PLATES **10**

Buckling of simply supported plates under compressive forces; governing equations the Navier solution- biaxial compression of a plate, uniaxial compression of a plate buckling of plates simply supported on two opposite edges; Levy"s solution- buckling of plates with various boundary conditions, general formulation; finite element analysis(elementary treatment only; discussion of various elements used and their capabilities- not for examination)

UNIT IV VIBRATION OF PLATES **9**

Governing equations for natural flexural vibrations of rectangular plates; natural vibrations of plates simply supported on all edges; vibration of plates with two parallel sides simply supported; Levy"s solution- vibration of plates with different boundary conditions; Rayleigh- Ritz method- Natural

vibration of plates with general boundary conditions; transient analysis of rectangular plates; finite element analysis (elementary treatment only;discussion of various elements used and their Capabilities- not for examination)

UNIT V ANALYSIS OF THIN ELASTIC SHELLS OF REVOLUTION 9

Classification of shell surfaces; geometric properties of shells of revolution; general strain displacement relations for shells of revolution; stress resultants; equations of motion of thin shells; analytical solution for thin cylindrical shells; membrane theory flexure under ax symmetric loads; shells with double curvature- geometric considerations, equations of equilibrium; bending of spherical shells; vibration of cylindrical shells; finite element analysis(elementary treatment only; discussion of various elements used and their capabilities- not for examination)

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- compute structural mechanic approximations of membrane, plates and shells.
- derive equations of membrane plate and shell for analysis.
- design a plate using buckling analysis of rectangular plates.
- determine the static, dynamic, non-linear motion of membrane, plate and shell structures.
- perform numerical approximations of all types of shells.

REFERENCES

1. Reddy,J.N., "Theory and Analysis of Elastic Plates & Shells", C.R.C .Press, NY,USA 2016.
2. Szilard, R., Theory and Analysis of Plates, Prentice Hall Inc.,2014
3. S.Timoshenko.,"Theory of plates and shells" McGraw Hill company, 2017.
4. Eduard Ventsel Theodor Krauthammer.," Thin Plates and Shells Theory, Analysis, and Applications". Marcel Dekker, 2001.

CO - PO Mapping

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COs	Programme Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	1	-	-	-	-	-	-	-	3	3	2
CO2	3	3	3	1	-	-	-	-	-	-	-	3	3	2
CO3	3	3	3	1	-	-	-	-	-	-	-	2	3	2
CO4	3	2	3	1	-	-	-	-	-	-	-	2	3	2
CO5	3	2	2	1	-	-	-	-	-	-	-	2	3	2

PED19554 **PLASTICITY AND METAL FORMING** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- study the theory of plasticity and its behavior.
- familiarize the concepts of constitutive relationships and plastic instability.
- analyze the problems of metal forming.
- evaluate sheet metal forming process and the theories involved.
- apply various advancements in metal forming processes

UNIT I THEORY OF PLASTICITY **9**

Theory of plastic deformation ; Engineering stress and strain relationship – Stress tensor, Strain tensor , Yield criteria's; Plastic stress strain relationship – Plastic work, Equilibrium conditions, Incremental plastic strain

UNIT II CONSTITUTIVE RELATIONSHIPS AND INSTABILITY **7**

Uniaxial tension test- Mechanical properties, Work hardening, Compression test, bulge test; plane strain compression stress; plastic instability in uniaxial tension stress; plastic instability in biaxial tension stress.

UNIT III ANALYSIS OF METAL FORMING PROBLEMS **12**

Slab analysis - Slip line method, upper bound solutions, statistically admissible stress field, numerical method; contact problems; effect of friction; thermo elastic Elasto plasticity, Elastovisco plasticity; Thermo mechanical coupling; Analysis of forging, rolling, extrusion and wire drawing processes; Experimental techniques of the evaluation of metal forming.

UNIT IV ANALYSIS OF SHEET METAL FORMING **8**

Bending theory; Cold rolling theory; Hill's anisotropic theory; Hill's general yield theory; Sheet metal forming Elements used, Mesh generation and formulation, Equilibrium equations, Consistent full set algorithm; Numerical solutions procedures; examples of simulation of simple parts; Bench mark tests; Forming limit Diagrams

UNITV ADVANCES IN METAL FORMING **9**

Orbital forging; Isothermal forging; Warm forging; Hot and Cold isotropic pressing; high speed extrusion- rubber pad forming, micro blanking, super plastic forming; Overview of Powder Metal techniques - Powder rolling, Tooling and process parameters

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- apply concepts of plasticity and its behavior in machine tool industries.

- analyze the mechanical properties of plastics and their instability.
- solve the metal forming problems for different shapes using different methods.
- demonstrate knowledge of sheet metal forming and various theories associated with it.
- apprise with various advancements in metal forming processes and their techniques.

REFERENCES

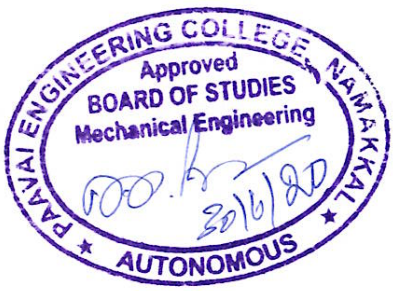
1. Dr.Sadhu singh, Theory of plasticity and metal forming process, khana publishers, reprint – 2018
2. J.Chakrabarty, Theory of plasticity, mcgraw-hill Ryerson, 2007.
3. Wagoner. R H., and Chenot. J.J., Metal Forming analysis, Cambridge University Press,2005.
4. Shiro Kobayashi, Altan. T, Metal Forming and Finite Element Method, Oxford University Press, 2001

CO - PO Mapping

Mapping of Course Outcomes with Programme Outcomes:

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programme Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	1	-	-	-	-	-	-	-	3	3	2
CO2	3	3	3	1	-	-	-	-	-	-	-	3	3	2
CO3	3	3	3	1	-	-	-	-	-	-	-	2	3	2
CO4	3	2	3	1	-	-	-	-	-	-	-	2	3	2
CO5	3	2	2	1	-	-	-	-	-	-	-	2	3	2



OPEN ELECTIVE

PMA19901 OPERATIONS RESEARCH 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the mathematical formulation of real-world problems as a linear programming model and apply the theoretical workings of the graphical and simplex method.
- develop various constructive techniques of Transportation and Assignment models to make effective business decisions.
- introduce the concepts of nonlinear programming problem to develop the quantitative tools for identifying, analyzing and practicing strategic decisions.
- develop various constructive techniques for the field of inventory and production management.
- impart knowledge to manage the project analysis by network models and organize the tools and techniques of CPM and PERT

UNIT I LINEAR PROGRAMMING 9

Principal components of decision problem, modeling phases, LP Formulation and graphic solution, Resource allocation problems, Simplex method.

UNIT II TRANSPORTATION AND ASSIGNMENT MODELS 9

Mathematical formulation of transportation problem; Methods for finding initial basic feasible solution, optimum solution, degeneracy; Mathematical formulation of assignment models - Hungarian Algorithm, variants of the Assignment problem.

UNIT III CLASSICAL OPTIMISATION THEORY 9

Nonlinear programming problem, Kuhn-Tucker conditions min cost flow problem, max flow problem.

UNIT IV INVENTORY MODELS 9

Inventory models, Economic order quantity models, Quantity discount models, Stochastic inventory models, Multi product models, Inventory control models in practice.

UNIT V NETWORKING MODELS 9

Network diagram representation, Critical path method, Time charts and resource levelling, PERT.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- demonstrate the mathematical formulation of real-world problems as a linear programming model and apply the theoretical workings of the graphical and simplex method.

- determine the optimal solution of maximizing the profit and minimizing the cost of both transportation and assignment problems.
- develop mathematical skills to analyse and solve Nonlinear programming problem.
- determine the optimization concepts in inventory control models.
- use CPM and PERT techniques to plan , schedule and Control project activities.

REFERENCES

1. Taha H.A., "Operations Research: An Introduction " 10th Edition, Pearson Education, 2017.
2. A.M.Natarajan, P.Balasubramani, A.Tamilarasi, "Operations Research", Pearson Education, Asia, 2013.
3. Prem Kumar Gupta, D.S. Hira, "Operations Research", S.Chand & Company Ltd, New Delhi, 3rd Edition, 2013.
4. John W. Chinneck "Feasibility and Infeasibility in Optimization Algorithms and Computational Methods", Springer, 2013.

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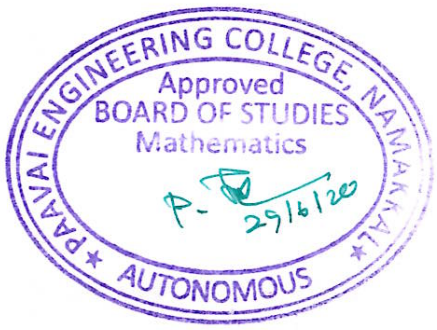
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	-	-	-	-	-	-	-	3	3	3
CO2	2	3	2	2	-	-	-	-	-	-	-	2	3	3
CO3	3	3	3	3	-	-	-	-	-	-	-	2	3	3
CO4	3	3	3	3	-	-	-	-	-	-	-	3	3	3
CO5	3	3	3	3	-	-	-	-	-	-	-	3	3	3



PSE19901 COST MANAGEMENT OF ENGINEERING PROJECTS 3 0 0 3

COURSE OBJECTIVES

To enable the students to,

- understand the costing concepts and their role in decision making
- apply project management concepts while selecting various projects
- interpret costing concepts with project execution
- analyze costing techniques and various budgetary control techniques which used in service sector
- compute solution for quantitative techniques in cost management

Prerequisite: Nil

UNIT I INTRODUCTION 9

Costing System- 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.

UNIT II 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.

UNIT III PROJECT EXECUTION AND COSTING CONCEPT 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.

UNIT 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.

UNIT V QUANTITATIVE TECHNIQUES FOR COST MANAGEMENT 9

Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon the completion of this course, the students will be able to

- apply the costing concepts in decision making
- select various projects based on project management concepts

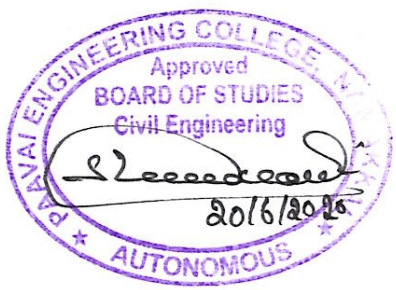
- execute the project with optimum costing concept
- use costing techniques and various budgetary control techniques in service sector
- solve quantitative techniques CPM/PERT in cost management.

REFERENCES

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi, 2018.
2. Charles T. Horngren and George Foster, Advanced Management Accounting, Prentice Hall of India, 2011.
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting, e-book.
4. Vohra N.D., Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd, 2007.
5. Cost management by Dr. J. Made Gowda, Himalaya Publishing House, 2013.

Co-Po Mapping:

Mapping of Course Objectives with Programme Outcomes: **(1/2/3 indicates strength of correlation) 3–Strong, 2–Medium, 1–Weak**														
Cos	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	2	-	2	-	-	2	3	-	3	2	1	-
CO2	2	2	2	-	2	-	-	-	2	-	3	3	-	2
CO3	3	1	3	-	3	1	-	-	-	-	3	3	-	1
CO4	3	2	3	-	3	-	3	-	-	-	3	2	1	2
CO5	3	2	2	-	3	1	2	-	-	-	3	3	1	2



PCE19901 BUSINESS ANALYTICS **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
- gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
- become familiar with processes needed to develop, report, and model business data.
- analyze and solve problems from different industries such as manufacturing, service, retail, banking and finance, sports, pharmaceutical, aerospace etc.
- use decision-making tools/operations research techniques.

UNIT I INTRODUCTION **9**

Business analytics- Overview of business analytics, scope of business analytics, business analytics process, relationship of business analytics process and organization, competitive advantages of business analytics; Statistical Tools- Statistical notation, descriptive statistical methods- data mining introduction.

UNIT II ANALYSIS **9**

Trendiness and Regression Analysis- Modeling relationships and trends in data, business analytics personnel, data and models for business analytics, problem solving, visualizing and exploring data, business analytics technology.

UNIT III MODELLING **9**

Organization Structures of Business analytics; Team management; Management Issues; Designing Information Policy; Outsourcing; Ensuring Data Quality; Measuring contribution of Business analytics; Managing Changes.

UNIT IV FORECASTING **9**

Forecasting Techniques- Qualitative and Judgmental Forecasting, statistical forecasting models, forecasting models for stationary time series, forecasting time series with seasonality, regression forecasting with casual variables. Monte Carlo Simulation - Monte carlo simulation using analytic solver platform, new-product development model, newsvendor model, overbooking model, cash budget model.

UNIT V DECISION MAKING **9**

Decision Analysis- Formulating decision problems, decision strategies with the without outcome probabilities, decision trees, value of information, utility and decision making.

TOTAL HOURS 45

COURSE OUTCOMES

Upon the completion of the course, the students will be able to

- understand the knowledge of data analytics.
- demonstrate the ability of think critically in making decisions based on data and deep analytics.
- demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.
- demonstrate the ability to translate data into clear, actionable insights.
- understand the concept of decision making.

REFERENCES

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dar G.Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.
3. The PMI guide to Business Analysis
4. Business Analysis for Practitioners: Practice Guide
5. Agile and Business Analysis Practical guidance for IT Professionals

CO/PO MAPPING

(1,2,3 indicates the strength of correlation) 3-strong,2-medium,1-less

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	1	1	1	-	1	2	-	1	2	1	-
CO2	2	2	2	1	1	1	-	1	2	-	-	2	2	-
CO3	2	2	2	3	1	1	-	1	2	-	-	2	2	2
CO4	2	2	2	3	1	1	-	1	2	-	-	2	2	1
CO5	2	2	2	2	1	1	-	1	2	-	-	2	2	1

PED19901 **INDUSTRIAL SAFETY** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- give exposure to various industrial safety equipment's and methods.
- understand tools used for maintenance cost and services life of equipment.
- analyze the types, causes, effects of wear reduction methods.
- enhance awareness of fault tracing concept and maintenance and types of faults in machine tools and their general causes.
- develop rudimentary ability on periodic inspection concept and needs of various mechanical and electrical equipment's.

UNIT I INDUSTRIAL SAFETY **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.

UNIT 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.

UNIT 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.

UNIT 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.

UNIT 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 PERIODS: 45

COURSE OUTCOMES

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

- differentiate the types of accident causes and preventive steps of industrial safety.
- assess the various types and applications of tools used for maintenance and its relation with economy.
- analyze the factors affect the corrosion and its prevention methods.
- identify the types of faults in machine tools and their general causes.
- analyze the various preventive maintenance of mechanical and electrical equipment's and repair cycle concepts.

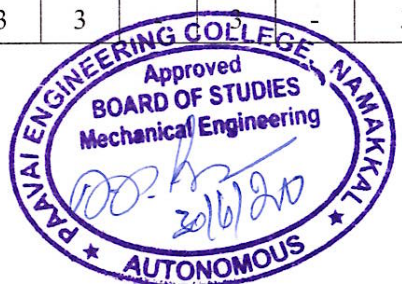
REFERENCES

1. Foundation Engineering Handbook, Hans F.Winterkorn, Hsai-yang fang, Chapman & Hall publishers London 2010.
2. Pump-hydraulic Compressors, Audels, Tata MC Graw hill Publication 2003.
3. Industrial Maintenance , H. P. Garg, S. Chand Ltd., 1987.
4. Maintenance Engineering Handbook, Higgins & Morrow, Tata MC Graw hill 1977.

CO - PO Mapping

Mapping of Course Outcomes with Programme Outcomes:
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programme Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	-	2	-	-	3	-	3	2	-	-	-	2	-
CO2	3	-	2	3	-	2	-	3	3	-	-	-	2	-
CO3	3	-	2	3	3	3	-	3	-	-	-	-	2	-
CO4	3	-	2	3	-	3	-	3	-	-	-	-	2	-
CO5	3	-	2	3	3	3	-	3	-	3	-	-	2	-



PED19902 **COMPOSITE MATERIALS** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- give exposure on composite materials and functional requirements of reinforcement matrix.
- understand the mechanical behavior of composites and its preparation methods.
- understand various manufacturing methods of metal matrix composites.
- develop the different preparation of moulding methods.
- enhance the awareness of laminar failure criteria

UNIT 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.

UNIT 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.

UNIT 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.

UNIT 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.

UNIT V STRENGTH **9**

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

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- apply the effect of reinforcement on overall composite performance.
- assess the mechanical behavior of composites, reinforcement properties and its applications.

- analyze the properties and applications of different metal matrix composites manufacturing.
- implement various manufacturing methods of polymer matrix composites and its applications.
- identify the various failure appeared in the composite laminate.

REFERENCES

1. Composite Materials Design and Applications – Danial Gay, 3rd edition, CRC press, taylor and francise grove 2014.
2. Composite Materials Science and Applications – Deborah D.L. Chung, 2nd edition, springer 2010.
3. Composite Materials – Science and Engineering K.K.Chawla, 2nd edition, springer, 1998
4. Hand Book of Composite Materials-edited by George Lubin , 1st edition , van Nostrand reinhold company inc 1982.

CO - PO Mapping

Mapping of Course Outcomes with Programme Outcomes:

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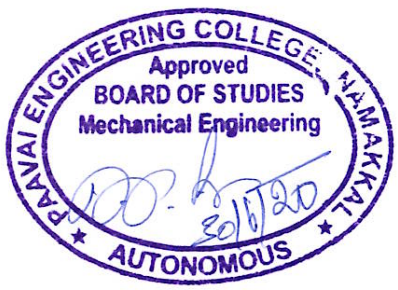
CO5	3	2	2	-	-	-	-	-	-	-	-	1	3	-



PED19903 **WASTE TO ENERGY** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- give exposure on energy from industrial waste.
- understand the manufacture of charcoal and pyrolytic oil and gases.
- develop biomass gasification design, construction and operation.
- enhance the knowledge in fluidized bed combustors and operation of biomass combustors.
- impart the knowledge on biogas plant technology and biomass conversion processes.

UNIT I INTRODUCTION TO ENERGY FROM WASTE **9**

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

UNIT II BIOMASS PYROLYSIS **9**

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

UNIT 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.

UNIT IV BIOMASS **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.

UNIT V BIOGAS **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 PERIODS: 45

COURSE OUTCOMES

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

- differentiate the types of conversion devices and energy from waste.

- assess the various methods of manufacturing of pyrolytic oils and its applications.
- analyze the different biomass gasifier and factor considered in gasifier operations.
- identify the operations, types and design consideration of fluidized bed combustor.
- analyze the different bio gas plant, application and urban waste energy conversion.

REFERENCES

1. Non Conventional Energy, Ashok V., Desai, New age international, 1990.
2. Biogas Technology - A Practical Hand Book – K.C. Khandelwal, and S.S.Mahdi, Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1989.
3. Food, Feed and Fuel from Biomass, Devinder singh.Chahal, IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, Charles. Y. WereKo-Brobby and Essel. B. Hagan, John Wiley & Sons, Newyork 1996.

CO - PO Mapping

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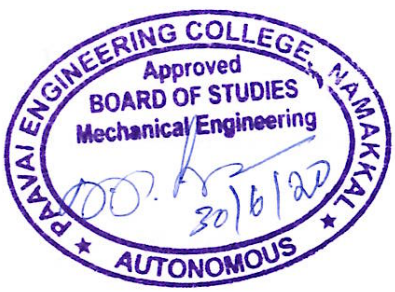
CO5	-	-	3	2	-	3	3	-	-	-	-	2	3	-



PMR1901 ENERGY MANAGEMENT IN THERMAL SYSTEMS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- familiarize with the present energy scenario and the need for energy conservation.
- know about the instruments suitable for energy auditing.
- gain knowledge on various measures for energy conservation for various thermal utilities.
- study the various thermal transmission and protection systems
- learn about energy financial management

UNIT I INTRODUCTION 10

Energy Scenario – world and India. Energy Resources Availability in India. Energy consumption pattern. Energy conservation potential in various Industries and commercial establishments. Energy intensive industries – an overview. Energy conservation and energy efficiency – needs and advantages. Energy auditing – types, methodologies, barriers. Role of energy manager – Energy audit questionnaire – energy Conservation Act 2003.

UNIT II INSTRUMENTS FOR ENERGY AUDITING 8

Instrument characteristics – sensitivity, readability, accuracy, precision, hysteresis. Error and calibration. Measurement of flow, velocity, pressure, temperature, speed, Lux, power and humidity. Analysis of stack, water quality, power and fuel quality.

UNIT III THERMAL UTILITIES: OPERATION AND ENERGY CONSERVATION 10

Boilers – High Pressure Boilers, Super Critical Boilers - Thermic Fluid Heaters – Furnaces - Waste Heat Recovery Systems - Thermal Storage.

UNIT IV THERMAL ENERGY TRANSMISSION / PROTECTION SYSTEMS 7

Steam traps – refractories – optimum insulation thickness – insulation – piping design.

UNIT V FINANCIAL MANAGEMENT 10

Investment – need, appraisal and criteria, financial analysis techniques – break even analysis – simple payback period, return on investment, net present value, internal rate of return, cash flows, Debt-Service Coverage Ratio (DSCR), financing options.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- explain the energy scenario and describe the need for energy conservation and auditing.
- have good knowledge on instrument characteristics and select appropriate instrument for energy auditing.
- describe operational aspects of thermal utilities and apply energy conservation measures.
- demonstrate knowledge on various thermal transmission and protection systems

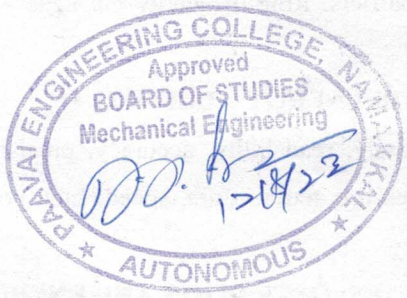
- apply financial analysis techniques for financial management in energy utilization.

TEXT BOOKS

1. W.C. turner, "Energy Management Hand book" Wiley, New York, 1982
2. L.C. Witte, P.S. Schmidt, D.R. Brown, "Industrial Energy Management and Utilisation" Hemisphere Publ, Washington, 1988.

REFERENCES

1. Energy Manager Training Manual (4 Volumes), Bureau of Energy Efficiency (BEE), A statutory body under Ministry of Power, Government of India.2004.
2. W.R. Murphy and G. McKay "Energy Management" Butterworths, London 1987
3. Eastop.T.D & Croft D.R, Energy Efficiency for Engineers and Technologists,.Logman
4. B L Capehart,William J Kennedy,Wayne C Turner, Guide to energy management, Fairmont Press ; New York, 2002



PMR1902 **ENERGY RESOURCES** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- understand concept of various forms of non-renewable and renewable energy.
- learn about solar energy and its applications.
- know about the concept of wind energy and its status in India
- study various bio-energy resources for utilization
- gain knowledge on other renewable energy resources like OTEC, Fuel cell etc

UNIT I COMMERCIAL ENERGY 9

Coal, Oil, Natural gas, Nuclear power and Hydro - their utilization pattern in the past, present and future projections of consumption pattern - Sector-wise energy consumption – environmental impact of fossil fuels – Energy scenario in India – Growth of energy sector and its planning in India.

UNIT II SOLAR ENERGY 9

Solar radiation at the earth's surface – solar radiation measurements – estimation of average solar radiation - solar thermal flat plate collectors - concentrating collectors – solar thermal applications - heating, cooling, desalination, drying, cooking, etc – solar thermal electric power plant - principle of photovoltaic conversion of solar energy, types of solar cells – Photovoltaic applications: battery charger, domestic lighting, street lighting, water pumping etc - solar PV power plant – Net metering concept.

UNIT III WIND ENERGY 9

Nature of the wind – power in the wind – factors influencing wind – wind data and energy estimation - wind speed monitoring - wind resource assessment - Betz limit - site selection – wind. energy conversion devices - classification, characteristics, applications – offshore wind energy - Hybrid systems - safety and environmental aspects – wind energy potential and installation in India - Repowering concept.

UNIT IV BIO-ENERGY 9

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 Plant - applications - alcohol production from biomass – bio diesel production – Urban waste to energy conversion - Biomass energy programme in India.

UNIT V OTHER TYPES OF ENERGY 9

Ocean energy resources - principle of ocean thermal energy conversion (OTEC) - ocean thermal power plant - ocean wave energy conversion - tidal energy conversion – small hydro -geothermal energy - geothermal power plant – hydrogen production and storage - Fuel cell –principle of working - various types - construction and applications.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

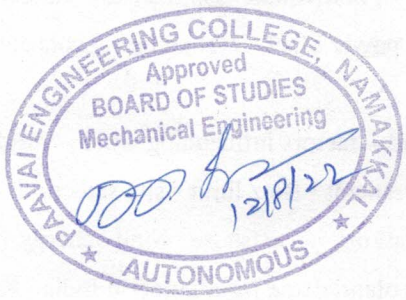
- illustrate various forms of Non-renewable and renewable energy for commercial use.
- discuss about solar energy principles and its utilization
- demonstrate knowledge on wind energy conversion devices and the scenario in India
- utilize bio-energy resources for different applications
- describe knowledge on other renewable energy resources like OTEC, Fuel cell etc.

TEXT BOOKS

1. Sukhatme S.P., "Solar Energy", Tata McGraw Hill, 1984.
2. Twidell J.W. and Weir A., "Renewable Energy Sources", EFN Spon Ltd., 1986.

REFERENCES

1. Kishore V.V.N., "Renewable Energy Engineering and Technology", Teri Press, New Delhi, 2012
2. Peter Gevorkian, "Sustainable Energy Systems Engineering," McGraw Hill,2007.
3. Kreith F. and Kreider J.F., "Principles of Solar Engineering", McGraw-Hill, 1978.
4. Godfrey Boyle, "Renewable Energy Power for a Sustainable Future", Oxford University Press, U.K, 1996.



PMR1903 ADVANCED POWER PLANT ENGINEERING 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand energy demand and the thermodynamics associated with power plants
- learn the details on the role of various utilities in coal based thermal power plants
- acquire knowledge on the know-how of the working of gas turbine and diesel power plants
- appreciate the concept of polygeneration for total energy recovery from a system
- gain knowledge on the working of hydroelectric and nuclear power plants.

UNIT I INTRODUCTION 9

Energy scenario: India Vs. World - Load curves and – Thermodynamic analysis of Conventional Power Plants (Coal, Gas Turbine and Diesel) - Advanced Power Cycles - Kalina Cycle, IGCC44.

UNIT II COAL BASED THERMAL POWER PLANTS 9

Basics of typical power plant utilities – Boilers, Nozzles, Turbines, Condensers, Cooling Towers, Water Treatment and Piping system – steam rate and heat rate – mean temperature of heat addition - Rankine cycle improvements – Superheat, Reheat, Regeneration, Super critical, AFBC/PFBC – computation of per unit cost of power generation from coal/biomass.

UNIT III GAS TURBINE AND DIESEL POWER PLANTS 9

Brayton cycle – Open and Closed – Improvements - Intercooler, Reheating and Regeneration. Diesel power plant – Layout - Performance analysis and improvement – Techniques for starting, cooling and lubrication of diesel engines - computation of per unit cost of power generation.

UNIT IV CHP AND MHD POWER PLANTS 9

Cogeneration systems – types - heat to power ratio - Thermodynamic performance of steam turbine, gas turbine and IC engine based cogeneration systems – Polygeneration - Binary Cycle - Combined cycle. MHD – Open cycle and closed cycle- Hybrid MHD& steam power plants.

UNIT V HYDROELECTRIC & NUCLEAR POWER PLANTS 9

Hydroelectric Power plants – classifications - essential elements – pumped storage systems – micro and mini hydel power plants. General aspects of Nuclear Engineering – Components of nuclear power plants - Nuclear reactors & types – PWR, BWR, CANDU, Gas Cooled, Liquid Metal Cooled and Breeder reactor - nuclear safety – Environmental issues - Computation of per unit cost of power generation.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- evaluate appropriate power generation technologies for mitigating the energy gap
- appraise the steam rate, heat rate and cost for generating electricity from coal based thermal

power plants

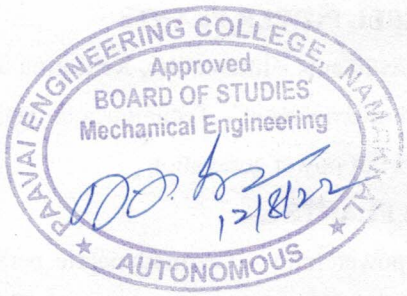
- analyse and suggest measures for improving the performance of gas turbine and diesel power plants
- assess the applicability and performance of a cogeneration system
- decide on a suitable type of hydroelectric/nuclear power plant commensurate with the prevailing conditions

TEXT BOOKS

1. Nag, P.K., Power Plant Engineering, Tata McGraw Hill Publishing Co Ltd, New Delhi, 1998.
2. Haywood, R.W., Analysis of Engineering Cycles, 4th Edition, Pergamon Press, Oxford, 1991.

REFERENCES

1. Wood, A.J., Wollenberg, B.F., Power Generation, operation and control, John Wiley, New York,1984.
2. Gill, A.B., Power Plant Performance, Butterworths, 1984.
3. Lamarsh, J.R., Introduction to Nuclear Engg.2nd edition, Addison-Wesley, 1983.
4. Larry Drbal, Kayla Westra, Pat Boston, Power Plant Engineering, Springer, 1995



PMR1904 ENERGY CONSERVATION IN INDUSTRIAL UTILITIES 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand different types boilers and their performance criteria.
- know the techniques adopted for performance evaluation of thermal utilities
- learn and appreciate the working principle employed in VCRS and VAM systems
- list the parameters considered in electricity billing and the losses associated with a motor
- comprehend the techniques available for energy conservation in electrical utilities.

UNIT I BOILERS 9

Types - Performances evaluation via direct and indirect method – energy conservation avenues. Properties of steam - Assessment of steam distribution losses - Steam trapping - Condensate and flash steam recovery system - Opportunities for energy saving in steam consumption systems.

UNIT II FURNACES AND THERMIC FLUID HEATERS 9

Furnaces and Thermic Fluid Heaters: Types - Performances evaluation via direct and indirect method – energy conservation avenues. Insulation and Refractory: types and application.

UNIT III HVAC AND WASTE HEAT RECOVERY 9

Vapour-Compression Refrigeration System (VCRS) – performance assessment – energy savings opportunities – Vapour Absorption Chiller (VAM): working, types, benefits, comparison with vapour compression system. WHR systems: Classification – Benefits - Commercial waste heat recovery devices: recuperator, regenerator, heat pipe, heat exchangers (Plate, Shell & Tube), heat pumps, thermo compressor. CHP – Polygeneration.

UNIT IV ELECTRICAL SYSTEMS AND INDUCTION MOTORS 9

Electricity billing - Demand side management - Power factor improvement transformer losses – Harmonics induction Motors : Types – Losses – performance assessment adopting direct and indirect method - Factors affecting motor performance - energy efficient motors.

UNIT V ENERGY CONSERVATION IN ELECTRICAL UTILITIES 9

Performance assessment and energy conservation avenues in : fans - blowers – pumps – air compressors - illumination systems - cooling towers.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- suggest measures for efficient combustion in different types of boilers
- discover the cause for underperformance of thermal utilities and suggest suitable remedial measures
- analyse the factors affecting the performance of VCR and VAR systems

- evaluate the performance of induction motors and transformers
- assess energy conservation avenues of thermal and electrical utilities

TEXT BOOKS

1. L.C. Witte, P.S. Schmidt, D.R. Brown, "Industrial Energy Management and Utilisation" Hemisphere Publ, Washington, 1988.
2. W.C. Turner, "Energy Management Hand book" Wiley, New York, 1982.

REFERENCES

1. Energy Manager Training Manual (4 Volumes), Bureau of Energy Efficiency (BEE), A statutory body under Ministry of Power, Government of India.2004.
2. W.R. Murphy and G. McKay "Energy Management" Butterworths, London 1987
3. Eastop.T.D& Croft D.R, Energy Efficiency for Engineers and Technologists,.Logman Scientific & Technical, 1990
4. Industrial Energy Conservation, Volumes 1-2, S. C. Bhatia; Puneet Mangla, Woodhead Publishing India, 2018

PMR1905 ENVIRONMENTAL BENEFITS OF ENERGY MANAGEMENT 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- become aware of the energy scenario of India with respect to world
- learn the methodology adopted for an energy audit
- appreciate the concepts adopted in project management
- study the different techniques adopted for financial appraisal of a project
- Comprehend the impact of energy on environment.

UNIT I ENERGY SCENARIO 9

Comparison of energy scenario – India and World (energy sources, generation mix, consumption pattern, T&D losses, energy demand, per capita energy consumption) – energy pricing – energy security - energy conservation and its importance - Energy Conservation Act 2001.

UNIT II ENERGY MANAGEMENT 9

Energy audit - need – types – methodology – barriers - analysis on energy costing and sharing - bench marking - fuel and energy substitution – billing parameters in TANGEDCO – demand side management - instruments for energy audit – energy monitoring and targeting – CUSUM – energy labelling.

UNIT III PROJECT MANAGEMENT 9

Four Basic Elements of Project Management - Project Management Life Cycle - Steps in Project Management - Project Definition and Scope, Technical Design, Financing, Contracting, Implementation Techniques (Gantt Chart, CPM and PERT) and Performance Monitoring.

UNIT IV FINANCIAL MANAGEMENT 9

Investment appraisal for energy conservation projects - Financial analysis techniques -Simple payback period, Return on investment, Net present value, Internal rate of return - Cash flows – Risk and sensitivity analysis : micro and macro factors - Financing options - energy performance contracts - ESCOs.

UNIT V ENERGY AND ENVIRONMENT 9

Greenhouse effect and the carbon cycle - current evidence and future effects of climate change - Global Environmental Concerns - United Nations Framework Convention on Climate Change (UNFCC), Kyoto Protocol, Conference of Parties (COP), Emissions trading (ET), Joint implementation (JI), Clean Development Mechanism (CDM), Prototype Carbon Fund (PCF), Sustainable Development.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- recognize the importance of energy conservation and suggest measures for improving per capita energy consumption
- analyse the energy sharing and cost sharing pattern of fuels used in industries

- apply Gantt Chart, CPM and PERT in energy conservation projects
- evaluate the techno-economics of a project adopting discounting and non-discounting Cash flow techniques
- assess the sources of additional revenue generation for energy conservation projects Adopting UNFCC and other climate conventions

TEXT BOOKS

1. W.C.turner, "Energy Management Hand book" Wiley, NewYork,1982
2. W.R.Murphy and G.McKay "Energy Management" Butter worths, London 1987

REFERENCES

1. Energy Manager Training Manual (4 Volumes), Bureau of Energy Efficiency (BEE), A statutory body under Ministry of Power, Government of India, 2004.
2. L.C. Witte, P.S. Schmidt, D.R. Brown, "Industrial Energy Management and Utilisation" Hemisphere Publ,Washington,1988.
3. Competitive energy management & environmental technologies, Jana Ricketts, Jana Ricketts Flanagan, Fairmont Press, 1995
4. Eastop.T.D & Croft D.R, Energy Efficiency for Engineers and Technologists, Logman Scientific & Technical, ISBN-0-582-03184, 1990.