SYLLABUS

For

Master of Engineering Programmes
(M.Tech. Production Engineering)

(For admission in 2022-23 and onwards)
## Course Structure and Scheme of Examination for M. Tech. - 2 Year Program
### Production Engineering

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Course Type/Code</th>
<th>Course Name</th>
<th>Teaching Scheme</th>
<th>Credits</th>
<th>Internal Marks</th>
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**Semester III**

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2 | Page
### Course Structure and Scheme of Examination for B.Tech.-M. Tech. Dual 1 Year Program
#### Production Engineering

**Semester III**

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**Abbreviations:** L-No. of Lecture hours per week, T-No. of Tutorial hours per week, P-No. of Practical hours per week, CT-Class Test Marks, TA-Marks of teacher’s assessment including student’s class performance and attendance,
<table>
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<th>1 Hr Lecture</th>
<th>1 Hr Tutorial</th>
<th>2 or 3 Hr Practical</th>
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<td>1 Credit</td>
<td>1 Credit</td>
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**Professional Electives 1**

1. PET- 305 Modelling and Simulation
2. PET- 306 Rapid Prototyping and Tooling
3. PET- 307 Supply Chain Management
4. PET- 308 Automated Material Handling System

**Professional Electives 2**

1. PET- 309 Facility planning and Value Engineering
2. PET- 310 Materials Managements
3. PET- 311 Computer Aided Process Planning
4. PET- 312 Total Quality Management

**Professional Electives 3**

1. PET- 313 Computational Methods in Engineering
2. PET- 314 Finite Element Methods
3. PET- 315 Metrology and Inspection
4. PET- 316 Advanced Forming Processes

**Professional Electives 4**

1. PET- 317 Industrial Automation and Robotics
2. PET- 318 Material Characterization
3. PET- 319 Metal Casting
4. PET- 320 Machine Tool Design

**Open Elective**

1. PET- 331 Waste to Energy
2. PET- 332 Cost Management of Engineering Projects
3. PET- 333 Industrial Safety
4. PET- 334 Operations Research
5. PET- 335 Composite Materials
6. PET- 336 Industrial Design and Ergonomics
Syllabus
Advanced Mathematics (AHT-301)

Course objectives:
From this course, students will be able to:
1. learn distinct methods of solving simultaneous equations.
2. well-versed with partial differential equations and their solutions and applications.
3. acquire the knowledge of transformation to ease the complex problems.
4. acquaintance with basics of random variables and their distribution for dealing with events by chance.
5. study different mathematical domains to deal with real-time engineering problems.

Learning outcomes:
1. Comprehend with engineering problems in different mathematical realm.
2. Learn analytical and numerical methods to deal with mathematical problems.
3. Understand how to model the engineering problems and their solutions.
4. Implement the solutions to real-time complex engineering problems.
5. Apprehend with mathematical methodology.

Course content:

Unit I: Solution of linear simultaneous equations: (8 hours)
Consistency, Iterative method, Convergence, Cholesky’s (Crout’s) method, Gauss-Jordan method, Gauss-Seidel iteration and relaxation methods, Solution of Eigenvalue problems, Smallest, largest, and intermediate Eigen values

Computer based algorithm and programme for these methods (non-evaluative)

Unit II: Partial differential equation and its applications: (10 hours)
Introduction and classification of partial differential equation, Four standard forms of non-linear partial differential equations and their solutions, linear equations with constant coefficients. Applications of partial differential equations one and two-dimensional wave equation, one and two-dimensional heat equation, Two-dimensional Laplace’s equation.
Unit III: Transform calculus-I: (8 hours)

Laplace transform, Properties of Laplace transform, Inverse Laplace transform, Applications of Laplace transform, Fourier integral theorem, Fourier transforms, Application of Fourier transform

Unit IV: Transform calculus-II: (8 hours)

Z-transform, Properties of Z-transform, Shifting theorems, Initial and final value theorem, Convolution theorems, Inverse Z-transform, Application of Z-transform

Unit V: Basic probability theory: (8 hours)

Concept and laws of probability, Discrete and continuous random variable and their distributions; Some special distributions such as Binomial, Poisson, Negative Binomial, Geometric, Continuous uniform, Normal, Exponential, Weibull, Moments, Moment generating functions, Expectation and variance

Practical demo with statistical software like R, SPSS, SAS, etc. (non-evaluative)

Text Books / References:
Syllabus

Machining Science (PET – 301)

L T P: 3 1 0 | Credits-4

Course objective
To expose the students to the different aspects of machining. Identify and use various methods and mechanism of machining.

Particulars

Unit 1: Mechanics of metal cutting
Chip formation, Types of chips, tool geometry-effect of rake, lead and clearance angles; Mechanics of orthogonal and oblique cutting, Shear angle relations in orthogonal cutting, Shear angle and chip flow direction in oblique cutting, Chip control methods, Analysis of cutting process, Machining with rotary tools.

Unit 2: Thermal aspects in machining
Heat and temperature distribution, modeling of chip formation in metal cutting, machining characteristics in turning, milling, drilling, grinding, etc., measurement of cutting forces and cutting temperatures. Economics of metal machining.

Unit 3: Cutting tools
Tools materials analysis of plastic failure (from stability criterion), Analysis failure by brittle fracture, wear of cutting tools, criterion, flank and crater wear analysis, optimum tool life, tool life equations, machining optimization, predominant types of wear; abrasive, adhesive, diffusion wear models, wear measurements and techniques, theory of tool wear, test of machinability and influence of metallurgy on machinability.

Unit 4: Abrasive machining
Mechanics of grinding, cutting action of grit, maximum grit chip thickness, energy and grit force temperature during grinding, Theory of wheel wear, High-speed grinding theory, grinding of drills, form cutters etc., testing of grinding wheels, mechanics of lapping and honing, free body abrasion.

Unit 5: Micro milling
References

11. Introduction to Machining Science by GK Lal New Age International.

Course outcome

CO1: To be able to understand the mechanism of metal cutting.
CO2: To be able to understand the thermal aspects in machining.
CO3: Understand the classification of various types of cutting tools and their geometry and design.
CO4: To be able to understand the concept of abrasive machining and free body abrasion.
CO5: Understand the importance of micro-milling and micro-drilling.
Syllabus

Industrial Tribology (PET – 302)

L T P: 3 1 0

Credits-4

Course objective
The impart knowledge on friction and methods to minimize wear of engineering components.

Unit 1
Introduction of tribology: Definition and Scope of tribology, Nature of metallic surface, surface geometry, measurement of surface topography, quantifying surface roughness, contact between surfaces Friction, the laws of friction, measurement of friction, origin of friction, theories of friction adhesion- theory, extension of the adhesion theory.

Unit 2
Wear: Types of wear, adhesive wear, Archard’s law, abrasive wear, erosion wear, factors affecting corrosive wear, wear map, various wear testing methods- pin on disc, pin on drum, slurry wear, air jet and water jet erosion as per ASTM standards.

Unit 3
Introduction of lubrication and Tribological properties of solid materials: Introduction of lubrication and need of lubrication, properties of lubrications, Hardness, strength, ductility and work hardening rate, effect of crystal structure, effect of microstructure, mutual solubility of rubbing pairs and effect of temperature.

Unit 4
Surface treatments to reduce wear: Surface treatments with or without change of composition, surface coating- welding, flame, spraying, plasma spraying, electroplating and electroless coating, chemical vapour deposition (CVD) and physical vapour deposition (PVD), super hard coatings.

Unit 5
Applications: Application of tribology in manufacturing processes, Metal machining, Metal cutting, Tool wear, Action of lubricants, Friction welding, Extrusion process.

References

1. Engineering Tribology P Sahoo Prentice Hall of India
2. Principles and Applications of Tribology D.F. Moore Pergamon Press
3. Fundamentals of Tribology Basu, Sengupta&Ahuja Prentice Hall of India
Course outcomes

CO1: Ability to understand the laws of friction.
CO2: Ability to understand different types of wear.
CO3: Capability to analyses tribological properties of solid materials.
CO4: Knowledge of basic principal of Coating.
CO5: Ability to understand the application of tribology.
Syllabus
Research Methodology and IPR (AHT-302)

L:T:P:: 2:0:0

Course Objectives: Students will be able to:
1. To understand the fundamentals of research in today’s world controlled by technology, ideas, concept, and creativity.
2. To understand different methods of research designing and data collections.
3. To understand the methods of report writing and its different methods of interpretations.
4. To understand research ethics and methods of research publications.
5. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Course Outcomes:
1. To understand research problem formulation.
2. To study research design and method of data collections.
3. To study methods of report writing.
4. To follow research ethics.
5. To enhance student’s competence to discover new inventions.

Syllabus Contents:

UNIT I: FUNDAMENTAL OF RESEARCH
Meaning of research; objectives of research; basic steps of research; criteria of good research; Research methods vs. Methodology. Types of research –criteria of good research; Meaning of research problem; selection of research problem; Approaches of investigation of solutions for research problem, Errors in selecting a research problem, Scope and objectives of research problem, Review of related literature- Meaning, necessity and sources.

UNIT 2: RESEARCH DESIGN AND DATA COLLECTION
Research design: Types of research design- exploratory, descriptive, diagnostic and experimental; Variables- Meaning and types; Hypothesis- Meaning, function and types of hypothesis; Null/Alternative hypothesis; Sampling- Meaning and types of sampling; Probability and Non-Probability; Tools and techniques of data collection- questionnaire, schedule, interview, observation, case study, survey etc.

UNIT 3: REPORT WRITING AND ITS INTERPRETATION
Unit 4: RESEARCH ETHICS AND SCHOLARY PUBLISHING

Ethics-ethical issues, ethical committees (human & animal); scholarly publishing- IMRAD concept and design of research paper, citation and acknowledgement, plagiarism and its concept and importance for scholar.

Unit 5: INTELLECTUAL PROPERTY RIGHT (IPR)


Reference Books:

2. Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”
Syllabus

Machining Science Lab (PEP – 301)

L T P: 0 0 3

Credits-1

Course objective
To expose the students to the different aspects of machining. Identify and use various methods and mechanism of machining.

Particulars

List of Experiments:

1. Study of the morphology of chips produced from different materials and machining processes.
2. Effect of tool geometry on chip flow direction in simulated orthogonal cutting conditions.
3. Study of cutting ratio/chip thickness ratio in simulated orthogonal cutting with different materials and tool geometry.
4. Evaluations of tool face temperature with thermocouple method.
5. Roughness of machined surface. Influence of tool geometry and feed rate.
6. Determination of cutting forces in turning.
7. Truing and dressing of the grinding wheel.
8. Study the micro-drilling and micro-milling operations.

References


**Course outcomes**

CO1: To be able to understand the morphology of chips produced.
CO2: To be able to understand the effect of tool geometry and chip thickness ratio.
CO3: Understand the measurement of tool face temperature and machined surface roughness.
CO4: To be able to understand the determination of cutting forces.
CO5: Understand the truing and dressing of grinding wheel, hands on operation on micro drilling.
Syllabus

Industrial Tribology Lab (PEP – 302)

L T P: 0 0 3

Credits-1

Course objective
The impart knowledge on friction and methods to minimize wear of engineering components.

Particulars

List of experiments
1. Study of wear characteristics of machine components.
2. To determine sliding wear rate of given sample.
3. To determine of abrasive wear rate of given sample
4. To Study of surface characterization of wear components.
5. To determine the hardness of given sample.
6. To study of D-GUN spray coating technique.
7. To study of HVOF spray coating technique.
8. To study of cold spray coating technique.
9. To study of application of industrial tribology.
10. To Study of air jet and water jet erosion.

References
1. Engineering Tribology P Sahoo Prentice Hall of India.

Course outcomes
CO1: Ability to understand the wear characteristics of machine components.
CO2: Ability to understand different types of wear.
CO3: Capability to analyses different coating techniques.
CO4: Knowledge of basic principle of erosion.
CO5: Ability to understand the application of industrial tribology.
Syllabus

Advanced Welding Technology(PET – 303)

L T P: 3 1 0
Credits-4

Course objective
To impart knowledge regarding various Fusion welding practices in industries. Moreover, this course also provides knowledge about the heat flow and chemical reactions and their influence on weld properties. The aspects about the metallurgical changes and weldability of different materials and their effects on weld properties also covered in this course.

Particulars

Unit 1
**Fusion Welding Processes:** Principle, Working and Application of fusion welding processes such as Gas welding, Gas Tungsten Arc welding, Gas Metal Arc Welding, Submerged Arc Welding, Resistance welding. Electroslag Welding, Electron beam welding, Plasma arc welding, Laser welding.

Unit 2
**Non-Fusion Welding Processes:** Principle, Working and Application of non-fusion welding processes such as such as Forge Welding, Friction Stir welding, Explosive welding, Diffusion welding, Ultrasonic welding,

Unit 3
**Heat flow and Chemical Reactions in welding**
Gas-Metal Reactions, Slag-metal Reactions,

Unit 4
**Welding Metallurgy and Weldability:**
Unit 5

**Weld Design:** Residual stresses (Causes, effects and remedies), Distortion (causes, effects and remedies), Fatigue (Mechanism, Fractography, S-N curve, Remedies), Non-destructive Testing of weldments, Weld design for static loading and fatigue loading.

**References:**

1. Welding Engineering and Technology-R. S. Parmer, Khanna Publishers
2. Welding Processes and Technology- R. S. Parmer, Khanna Publishers
5. ASM Handbook vol.6, welding Brazing & Soldering

**Course outcomes**

**CO1:** Students are introduced to various fusion and non-fusion welding techniques which make them interested to choose a career in the field of welding.

**CO2:** Students will be familiar with various welding process parameters and techniques and capable to select most suitable welding procedure and consumables for a product/process.

**CO3:** Students will understand the advanced welding practices in Industries and their comparative merits and demerits.

**CO5:** Students are demonstrated to develop the knowledge and skills in advanced welding processes, weld design using the various thermal and metallurgical considerations against various defects and final quality testing of weldments to secure employments.

**CO5:** Students will be able to choose the choose appropriate welding processes, right kind of welding techniques, weld design to minimize the occurrence of various weld defects or distortion with the aim of maximizing process efficiency and weld quality.
Syllabus

Computer Integrated Manufacturing (PET – 304)

L T P: 3 1 0             Credits-4

Course objective
The course provides an overview of computer integrated manufacturing.

Particulars

Unit 1:
Introduction: Introduction to manufacturing system and their analysis. CIM-Basic concepts, Evolution of CIM Manufacturing Automation protocol.

Unit 2:

Unit 3:

Flexible manufacturing System: Introduction, elements of FMS, Cell technology and FMS, optimization of FMS.

Unit 4:
Material Handling & Storage: Overview of material handling equipment, automated material handling equipment- A.G.V, features, function, types and safety consideration of AGV, Conveyers.

Analysis of material storage system: ASRS and caroused storage, Analysis of storage system.

Unit 5:
Manufacturing Support Functions: Introduction to computer aided process planning (CAPP), Just-in-time and Lean Production, MRP I&II, Concurrent engineering.

References

Course Outcomes

CO1: Able to understand the manufacturing system and their analysis.
CO2: Able to understand the concepts of numerical control.
CO3: Able to understand the concepts of group technology and flexible manufacturing system.
CO4: Able to understand the concepts of material handling and material storage system.
CO5: Able to understand the concepts of manufacturing support functions.
Syllabus

Advanced Welding Technology Lab (PEP – 303)

L T P: 0 0 3

Credits-1

Course objective
To impart practical exposure about Fusion welding (Gas Welding, Resistance spot welding, GTAW welding and GMAW welding) practices applied in industries. Moreover, the practical knowledge about the metal spraying and the changes in hardness and wear properties of coated-film also covered. At more outset, the practical knowledge about various non-destructive testing (Dye-Penetrant, Magnetic Particle, Ultrasonic, eddy current) of defects occurred in weldments also explored.

Particulars

List of Experiments

A minimum of 08 experiments from the following:

1. Experiment on Gas Welding to find out the mechanical properties of metals
2. Experiment on Resistance Spot Welding to find out the mechanical properties of metals
3. Experiments on GTAW (TIG) welding to find out the mechanical properties of metals
4. Experiments on GMAW (MIG) welding to find out the mechanical properties of metals
5. Experiments on Friction Stir Welding to find out the mechanical properties of metals
6. Experiment on Metal Spraying and to study the tribological properties of coated film
7. Experiment on Metal Spraying and study the hardness of coated film
8. Dye-Penetrant Testing of weldments
9. Magnetic Particle Inspection of weldments
10. Ultrasonic testing of weldments
11. Eddy current testing of weldments
12. Thermo-mechanical design and stress analysis using any FEM package

References

1. Welding Engineering and Technology-R. S. Parmer, Khanna Publishers
2. Welding Processes and Technology- R. S. Parmer, Khanna Publishers
5. ASM Handbook vol.6, welding Brazing & Soldering
Course outcomes
At the end of this course, student is able to

**CO1**: Understand the working principle of Gas and Resistance spot welding along with the hand on experience.

**CO2**: Understand the working principle of MIG and TIG welding and also have hand on experience of these welding techniques.

**CO3**: Understand the working principle of friction stir welding.

**CO4**: Understand the concept for metal spraying.

**CO5**: Understand and apply the testing methods of welding.
Syllabus

Computer Integrated Manufacturing Lab(PEP – 304)

L T P: 0 0 3 Credits-1

Course objective
The course provides an overview of CNC part programming skill for turning and milling operations.

Particulars

List of Experiments (Minimum 8 of the following)

1. To write a program to obtain the facing cycle in the CNC lathe.
2. To write a program to obtain the turning cycle in the CNC lathe.
3. To write a program to obtain the step turning cycle in the CNC lathe.
4. To write a program to obtain the taper turning cycle in the CNC lathe.
5. To write a program to obtain the Circular Interpolation in the CNC lathe.
6. To write a program to obtain the Drilling Cycle in the CNC lathe.
7. To write a program to obtain the Threading Cycle in the CNC lathe.
8. To write a program to obtain the Grooving Cycle in the CNC lathe.
9. To write a program to obtain linear and circular interpolation on the given work piece.
10. To write a program to engrave the letters “(college name)” on the given work piece.
11. To write a program to perform the mirroring operation.
12. To write a program to perform the Rotation operation on the given work piece.
13. To write a program to perform the Circular pocketing operation on the given work piece.
14. To write a program to perform the rectangular pocketing operation on the given work piece.

References


**Course Outcomes**

**CO1**: Able to demonstrate the working with different equipment to test the basic concepts in NC technology for applications in industry.

**CO2**: Able to apply the concepts in NC technology for milling operation to solve complex industrial problems.

**CO3**: Able to apply the concepts in NC technology for turning operation to solve complex industrial problems.

**CO4**: Able to design the different types of critical programs as a group to execute the projects related to CIM.

**CO5**: Able to improve their programming skills.
Syllabus

Modeling and Simulation(PET – 305)

L T P: 3 0 0   Credits-3

Course objective

To understand the concept of modeling and simulation. To classify and use various modeling and simulation methods.

Particulars

Unit 1: Introduction to modeling
Concept of system, continuous and discrete systems; Types of models and simulation; Discrete event simulation: Time advance mechanisms, components and organization of simulation model, steps in simulation study.

Unit 2: Statistical models in simulation
Discrete, continuous, Poisson and empirical distributions, output data analysis for a single system, comparing alternative system configurations, statistical procedures for comparing real world observations with simulation output data, generation of arriving processes, verification and validation of simulation models.

Unit 3: Stochastic simulation
Random number generation: Properties of random numbers, techniques of generating random numbers, generation of random varieties, Monte Carlo simulation and its applications in queuing models and inventory models.

Unit 4: Simulation of manufacturing and material handling systems
Models of manufacturing systems, models of material handling systems, goals and performance measures; Issues in manufacturing and material handling simulation: Modeling downtime failures, trace driven models.

Unit 5: Case studies on simulation packages
Simulation of queuing system (bank/job shop), simulation of manufacturing and material handling systems.
References


Course outcomes

CO1: To be able to understand the types of modeling and simulation.
CO2: To be able to understand the static model in simulation.
CO3: Understand the concept of stochastic simulation.
CO4: To be able to understand the simulation of manufacturing and material handling systems.
CO5: Understand the case studies on simulation packages.
Syllabus

Rapid Prototyping and Tooling (PET – 306)

L T P: 3 0 0

Credits-3

Course objective

The objective of rapid prototyping is how a part will design and development of a new product, in present era it is highly essential to be able to prepare final product or its prototype at the earliest. This is desirable to ensure that all the expected requirement of product are addressed and if required, its performance is also assessed from the prototype. Rapid prototyping offers a convenient option for manufacturing of product or its prototype from the CAD model.

Particulars

Unit 1

Introduction: Historical developments, Fundamentals of RP Systems and its Classification, Rapid prototyping process chains, 3D modeling and mesh generation, Data conversion and transmission.

Unit 2

RP Systems: Liquid polymer based rapid prototyping systems, Teijin Seiki’s solid form and other similar commercial RP systems, Solid input materials based rapid prototyping systems, laminated object manufacturing (LOM) and fused deposition modelling systems etc.

Unit 3

Power based rapid prototyping systems, selective Laser sintering, SoligenDiren’s shell production casting (DSPC), Fraunhofer’s multiphase jet solidification (MJS) and MIT’s 3D printing (3DP) etc.

Unit 4

RP Database: Rapid prototyping data formats, STL format, STL file problems, STL file repair, Network based operations, Digital inspection, Data warehousing and learning from process data.

Unit 5

Rapid Tooling: Conventional Tooling Vs. Rapid Tooling, Classification of Rapid tooling, Direct and Indirect Tooling Methods, Soft and Hard Tooling methods.
RP Applications: Development of dies for molding, RP applications in developing prototypes of products, application in medical fields, Development of bone replacements and tissues etc., RP materials and their biological acceptability.

References:


Course outcomes

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

CO1: Describe product development, conceptual design and classify rapid prototyping systems; explain stereo lithography process and applications
CO2: Explain direct metal laser sintering, LOM and fusion deposition modeling processes
CO3: Demonstrate solid ground curing principle and process
CO4: Discuss Rapid prototyping data formats, STL format, Digital inspection and Data warehousing.
CO5: Use appropriate tooling for rapid prototyping process and point out the application of RP System in medical field.
Syllabus

Supply Chain Management (PET – 307)

L T P: 3 0 0

Course objective
This course aims to provide an introduction industry demand. Our Supply Chain Management program will prepare you to: Understand fundamental supply chain management concepts. Apply knowledge to evaluate and manage an effective supply chain.

Particulars

Unit 1
**Introduction:** Understanding supply chain, supply chain performance; supply chain drivers and obstacles.

Unit 2
**Planning Demand and Supply in a Supply Chain:** Demand forecasting in supply chain, aggregate planning in supply chain, planning supply and demand; managing predictable variability, Economic Order Quantity Models, Reorder Point Models, Multi-echelon Inventory Systems.

Unit 3
**Planning and Managing inventories in a Supply Chain:** Managing economies of supply chain, managing uncertainty in a supply chain, determining optimal levels of product availability.

Unit 4
**Transportation, Network Design and Information Technology:** Transportation aspects in a supply chain, facility Decision, Network design in a supply chain, Information technology and its use in supply chain.

Unit 5
**Coordination in Supply Chain and effect of E-Business:** Role of Coordination and E-business in a supply chain; financial evaluation in a supply chain.
References


Course outcomes
CO1: Able to apply metrics in supply chains.
CO2: Able to define the principles of scheduling and planning in supply chain management.
CO3: Able to apply the principles of Strategic/Master planning of resource in supply chains.
CO4: Able to identify the principles of customer and supplier relationship management in supply chains.
CO5: Able to define the principles of quality and lean manufacturing.
Syllabus

Automated Material Handling System (PET – 308)

L T P: 3 0 0 Credits-3

Course objective
To introduce various automated material handling equipment and their utilization.

Particulars
Unit 1: Introduction of Material Handling
Overview of MHE, consideration in MHS design, twenty principles of material handling. The unit load concept.

Unit 2: Material Transport Systems
Industrial trucks, automated guided vehicle systems, monorails and other rail guided vehicles, conveyor systems, cranes and hoists.

Unit 3: Evaluation and Selection of Material Handling Layout
Design of bins and hoppers – flow patterns, measurement of flow properties, design methods, feeders, dischargers, silos, chutes and gates; Bulk material sampling and weighing systems, blending of bulk materials.

Unit 4: Analysis of Material Transport Systems
Rate of deliveries, required number of vehicles, economics of material handling systems.

Unit 5: Automated Storage & Retrieval Systems (AS/RS)
Functions of AS/RS, operations of AS/RS, AS/RS components, types of AS/RS, design of an AS/RS, system throughput, size parameters determination of AS/RS.

References
Course Outcomes

CO1: Ability to understand the material handling.

CO2: Ability to understand different types handling devices.

CO3: Knowledge of basic principle of material handling layout.

CO4: Capability to analyses economic aspect of material handling.

CO5: Ability to understand the material storage.
Syllabus

Facility Planning and Value Engineering(PET – 309)

L T P: 3 0 0 Credits-3

Course objective
Provide students with the ability to apply plant layout design procedure to design a new facility and ability to select a suitable location for new facility with the use of different techniques.

Particulars

Unit 1
Plant layout, material handling and their interrelationship, objectives of a good plant layout, principles of a good layout, classical types of layouts, special types and practical layouts. Factors affecting plant layout: man, material, machine, movement, waiting, service, building and change, features and considerations of each factor, procedure of plant layout, data collection for layout design, layout visualization using templates and 3D models.

Unit 2
Various theories/models of site location like equal weights, variable weights, weight cum rating, composite model and Bridgeman’s model, Weber index, and various subjective techniques, evaluation of layout, computerized layout, flowcharts of various Programmes like CRAFT, ALDEP AND CORELAP.

Unit 3
Principles, factors affecting material handling, objectives, material handling equation, selection of material handling systems and equipments, cranes, conveyors, hoists and industrial trucks, installation of new facilities in the existing setup using median model and gravity model.

Unit 4
Methodology of value engineering, unnecessary costs, use and prestige value, estimation of product quality or performance. Types of functions functional cost and functional worth. Effect of value improvement on profitability, tests for poor value.

Unit 5
Aims and objectives of value engineering, systematic approach. Value engineering, job plan-study of various phases of the job plan. Selection of projects for value analysis. Primary and secondary functions work and sell functions, determining and evaluating functions, assigning equivalence, function-cost matrix evaluation. Function (FAST). Reporting, implementation & follow up.
References


Course Outcomes

At the end of this course, student is able

CO1: To select a suitable location amongst the available locations for setting up a new facility.
CO2: To decide about the particular production process flow strategy.
CO3: To design a layout for the new facility to suit the company’s production process structure.
CO4: To select proper type of equipment for storage and movement of material.
CO5: To create the value engineering team and discuss the value engineering case studies.
Syllabus

Materials Management (PET – 310)

L T P: 3 0 0

Course objective

To expose the students to the different components and functions of material management.
Identify and use various search and matching techniques used in material management.

Particulars

Unit 1: Introduction to material management
Materials objectives, Policy manual: UNIDO Recommendations, Purchase policy, Purchasing cycle, purchase order, Materials Intelligence, Specification and standardization in Materials Management, Make or buy decision, buying process.

Unit 2: Materials planning and control
Material forecasting, Selection inventory control, Spare parts management, Inventory systems, Lead time analysis, administrative lead time, Supplier lead time, Transport lead time and Inspection lead time, Flow charting techniques to reduce various types of lead Time, Materials requirement planning, Aggregate inventory management.

Unit 3: Storage and distribution management
Codification of materials, Storage design, Stores layout, Storage systems and equipment, Stores preservation, Stores procedures, Stock valuation and verification ware housing, Distribution management.

Unit 4: Purchase policies and purchasing
Purchasing policies and procedures, Legal aspects of purchasing, Selection of sources of supply, Vendor evaluation and rating, Vendor development, Cost analysis.

Unit 5: Materials management and budgeting
Ethical buying, Performance indicators, Materials management controls, Budgetary control, Computer in materials management, Computer revolution, Software and hardware, Materials information system, Reports and information needs, Application and limitations of computers.
References


Course Outcome

CO1: To be able to understand the specification and standardization in Materials Management.
CO2: To be able to understand the Material forecasting, Selection inventory control, Spare parts management, Inventory systems.
CO3: Understand the concept of storage and distribution management.
CO4: To be able to understand the purchasing and purchase policies.
CO5: Understand the importance of materials management and budgeting.
Syllabus

Computer Aided Process Planning (PET – 311)

L T P: 3 0 0  Credits-3

Course objective

The course provides an overview of computer aided process planning.

Particulars

Unit 1:
Introduction: Traditional process planning, product design evaluation, various steps in process planning.

Unit 2:
Group Technology: Introduction, advantages, part families, classification and coding systems, production flow analysis, design of machine cells.

Unit 3:
Concepts Related to Process Planning: Machinability data system, cutting condition optimization.

Unit 4:
Automated Process Planning: Advantages of automated process planning, various approaches to process planning; Variant process planning, its features and different stages, different variant systems; Generative and semi-generative process planning, its features, design strategies, planning, modeling and coding scheme, decision mechanisms; Process capability analysis, intelligent process planning system; Artificial intelligence -- overview and application in process planning; Various recent process planning systems; Case studies.

Unit 5:
Interfaces of Process Planning: Integrating with loading, scheduling, MRP II, and capacity planning and other shop floor functions.
References


Course Outcomes

At the end of this course, student is

CO1: Able to understand the basics of process planning.
CO2: Able to understand the concepts of group technology
CO3: Able to understand the concepts related to machinability data system and cutting condition optimization.
CO4: Able to understand the automated process planning and artificial intelligence.
CO5: Able to understand the interfaces of process planning.
Total Quality Management (PET – 312)

Course objective
To provide knowledge and understanding about the Total Quality Management (TQM), its concepts, tools and techniques.

Particulars

Unit 1:
Introduction: The concept of TQM, Quality and Business performance, attitude and involvement of top management, communication, culture and management systems. Management of Process Quality: Definition of quality, Quality Control, a brief history, Product Inspection vs, Process Control, Statistical Quality Control, Control Charts and Acceptance Sampling.

Unit 2:
Customer focus and satisfaction: The importance of customer satisfaction and loyalty, Satisfied customers, Understanding the customer needs, Process Vs. Customer, internal - customer conflict, quality focus, Customer Satisfaction, role of Marketing and Sales, Buyer – Supplier relationships. Benchmarking: Evolution of Benchmarking, meaning of Benchmarking, benefits of benchmarking, the benchmarking process, pitfalls of benchmarking.

Unit 3:
Organizing for TQM: The systems approach, Organizing for quality implementation, making the transition from a traditional to a TQM organizing, Quality Circles. Productivity, Quality and Reengineering: The leverage of Productivity and Quality, Management systems Vs. Technology, Measuring Productivity, Improving Productivity Re-engineering.

Unit 4:
The cost of Quality: Definition of the Cost of Quality, Quality Costs, Measuring Quality Costs, use of Quality Cost Information, Accounting Systems and Quality Management.

Unit 5:
ISO 9000: Universal Standards of Quality: ISO around the world, The ISO 9000 ANSI/ASQCQ-90 Series Standards, benefits of ISO 9000 certification, the third party audit, Documentation ISO 9000 and services, the cost of certification implementing the system.
References

Course Outcomes
CO1: Students will be able to gain knowledge and understanding of the philosophies which have enabled the development of organizational quality improvement programs.
CO2: Students will be able to pursue the customer focus and satisfaction methodology.
CO3: Students will gain knowledge about the organization structure for TQM.
CO4: Students will understand the cost of quality.
CO5: Students will gain knowledge about ISO 9000.
Syllabus

Computational Methods in Engineering(PET – 313)

L T P: 3 1 0

Course objective
The primary goal is to provide engineering majors with a basic knowledge of computational methods including: root-finding, elementary numerical linear algebra, integration, interpolation, solving systems of linear equations, and numerical solution to ordinary differential equations. The computational methods learned in this course enable students to work with mathematical models of technology and systems.

Particulars

Unit 1: Solution of Algebraic and Transcendental Equation

Unit 2: Interpolation and Approximation
Finite differences, Newton forward and backward interpolation formula for finite differences, Gauss’s forward and backward interpolation formula, Stirling’s formula, Bessel’s formula, Laplace-Everett’s formula, Lagrange’s interpolation formula, Newton’s divided difference formula, Cubic spline.

Unit 3: Solution of Linear Simultaneous Equations
Cholesky’s method, Crout’s method, Jacobi’s iteration method, Gauss-Seidel iteration method, Relaxation method, Eigen values and eigen vectors, Power method.

Unit 4: Numerical Differentiation and Integration
Numerical differentiation using difference operators, Newton-Cotes quadrature formula, Trapezoidal Rule, Simpson’s one third rule, Simpson’s three eighth rule, Boole’s rule, Weddle’s rule.

Unit 5: Solution of Differential Equations
References

1. Numerical Methods by SukhenduDey and Shishir Gupta, Mc-Graw Hill
2. Numerical Methods by B.S. Grewal, Khanna Publications
5. An Introduction to Numerical Analysis by K.E. Atkinson, John Wiley & Sons, NY
6. Introduction Methods of Numerical Analysis by S.S. Sastry, Prentice Hall of India

Course Outcomes

CO1: To assess the approximation techniques to formulate and apply appropriate strategy to solve real world problems.
CO2: To find numerical solutions to system of linear equations and transcendental equations.
CO3: To find numerical solutions of integration, differentiations, linear equations, ordinary differential equations, interpolations.
CO4: To use numerical methods in modern scientific computing.
CO5: To understand the finite precision computation.
Syllabus

Finite Elements Methods(PET – 314)

L T P: 3 1 0 Credits-4

Course objective
To equip students with fundamentals of finite element principles. Moreover, physical and engineering problems with emphasis on structural and thermal engineering applications also covered in this course.

Particulars

Unit 1: Introduction to Finite Element Analysis and Finite Element Formulation Techniques
Introduction, Basic Concepts of Finite Element Analysis, Introduction to Elasticity, Steps in Finite Element Analysis.

Unit 2: Element Properties

Unit 3: Analysis of Frame Structures
Stiffness of Truss Members, Analysis of Truss, Stiffness of Beam Members, Finite Element Analysis of Continuous Beam, Plane Frame Analysis, Analysis of Grid and Space Frame.

Unit 4: FEM for Two- and Three-Dimensional Solids

Unit 5: Additional Applications of FEM
References

1. Introduction to Finite Elements in Engineering by T. R. Chandrupatla and A. D. Belegundu, Pearson Education.
2. Finite Element Methods: Basic concepts and applications by Chennakesava R. Alavala, PHI publications.
7. Finite Element and Approximation by O.C. Zenkiewicz& Morgan

Course Outcomes

CO1: Students should be able to understand the basic Concepts of Finite Element Analysis.
CO2: Students will be able to understand the Finite Element Formulation Techniques.
CO3: Students should have the knowledge about the Finite Element Properties
CO4: Students will be able to understand the analysis of Frame Structures
CO5: Student should have a knowledge about the applications of FEM.
Syllabus

Metrology and Inspection(PET – 315)

L T P: 3 1 0 Credits-4

Course objective
To learn various concepts of instrumentation, metrology & computer assisted inspection.

Particulars

Unit 1

Significance of Measurement and Instrumentation:
Introduction; generalized configuration and functional stages of measuring systems. The transducer and its environment; an overview; sensing process and physical laws. Types of measurement problems, Transducer classification and their modeling; Information, Energy and Incremental Models; Characteristics of instruments, design and selection of components of a measuring system.

Dynamic Response of Instruments:
Mathematical model of a measuring system, response of general form of instruments to various test inputs; time-domain and frequency domain analysis. Elementary transfer functions and Bode plots of general transfer functions.

Unit 2

Errors in Measurement and its Analysis:
Causes and types of experimental errors; systematic and random errors. Uncertainty analysis; computation of overall uncertainty; estimation for design and selection for alternative test methods.

Transducers and Transduction Principles:
Developments in sensors, detectors and transducer technology; displacement transducers; force, torque and motion sensors; piezoelectric transducers; capacitive type transducers; Strain gage transducers; accelerometers, pressure transducers based on elastic effect of volume and connecting tubing.

Unit 3

Metrology and Techniques:
Surface and form metrology:
flatness, roughness, waviness cylindricity, etc., Methods of improving accuracy & surface finish, Influence of forced vibration on accuracy, Dimensional wear of cutting tools and its influences on accuracy.

Unit 4

Standards for length measurement standards and their calibration:

Laser Applications in Metrology:
LASER light source, LASER interferometer, LASER alignment telescope, LASER micrometer, Online and in-process measurements of diameter, Roundness and surface roughness using LASER, Micro holes and topography measurements, straightness and flatness measurement.

Unit 5

Special Measuring Instruments and Techniques:
Optoelectronic devices, contact and non-contact types, Applications in on-line and in-process monitoring systems, Tool wear measurement, Surface measurement, Machine vision, shape identification, Edge detection techniques, Normalization, gray scale correlation, Template Techniques, Surface roughness using vision system, Interfacing robot and image processing system.

Sensors in Inspection:
Manufacturing applications of photo detectors, deflection methods-beam detection, Reflex detection, & Proximity detection, Applications of Inductive and Capacitive proximity sensors, Understanding microwave sensing applications laser sensors and limit switches. Advanced sensor technology-Barcode systems, Principles and applications of Colour sensors, electro-magnetic identifier, Tactile sensors, Ultrasonic sensors, Odour sensors.

References
2. Engineering Metrology G. Thomas and G. Butter Worth PUB.
7. Publications, Manufacturing processes and Ulzmann NY.

Course outcomes
At the end of the course
CO1: Students are able to understand the significance of measurement and instrumentation.
CO2: Students are able to have an eye view of errors in measurement and its analysis.
CO3: Students are able to understand the metrology techniques.
CO4: Students are able to understand the measurement standards, their calibration and laser application in metrology.
CO5: Students are able to know the advanced measuring instrumentation and techniques.
Syllabus

Advanced Forming Process(PET – 316)

L T P: 3 1 0

Course objective
Understanding the mechanism of deformation for different metal forming processes and develop analytical relation between input and output parameters of process, the concept of yield criteria applicable to different material deformation processes. Apply theoretical and experimental techniques for measurement of important outcomes of metal forming processes. To understand the different lubrication mechanisms, lubricants and other valuable affecting the metal forming processes under different working conditions & the different types of defects, causes and apply their remedial measures in metal forming processes.

Particulars

Unit 1

Introduction: Stress/strain/strain-rate characteristics of materials, Yield criteria, classification of metal working processes, Formability and theory of sheet metal working, Friction and lubrication in metal working operation, Theories of friction and lubrication, Assessment of friction at interface.

Unit 2

Process Analysis: Introduction to metal forming, Cold and hot working processes, failure criterion, Various methods of analyzing the metal working processes (slip-line field theory, Upper bound Solution, stab methods). Rolling: Determination of rolling pressure, roll separating force, driving torque and power, Power loss in bearings.

Unit 3


Unit 4

Hydrostatic Extrusion: Comparison with conventional extrusion, Pressure required to extrude, variables affecting the processes. Hydrostatic extrusion, Punching & Blanking-Mode of metal
deformation and failure, 2D deformation model and fracture analysis, Determination of work force.

Unit 5

High Speed Forming: Classification, Comparison of low and high-speed forming, operation problems in high-speed forming operation, Introduction to high forming process such as explosive forming, Electrical and Mechanical high-speed forming techniques. Defects in metal forming and applications of metal forming.

References

1. An Introduction to the Principles of Metal Working by Rowe Arnold.
2. Metal Forming Analysis by Avitzur, McGraw Hill
4. Plasticity for Mechanical Engineers by Johnson &Mellore Van Nostrand
5. High Velocity Working of Metals, ASTME EEE
6. Manufacturing Science by Ghosh & Mallik, Affiliated East-West
7. Technology of Metal Forming Processes by S. Kumar, Prentice Hall of India

Course Outcomes

CO1: Able to understand and apply the mechanism of deformation for different metal forming processes and develop analytical relation between input and output parameters of process.
CO2: Able to understand and analyze the concept of yield criteria applicable to different material deformation processes.
CO3: Able to apply theoretical and experimental techniques for measurement of important outcomes of metal forming processes.
CO4: Able to understand the different lubrication mechanisms, lubricants and other valuable affecting the metal forming processes under different working conditions.
CO5: Able to understand the different types of defects, causes and apply their remedies.
Syllabus

Industrial Automation and Robotics (PET – 317)

L T P: 3 0 0

Credits-3

Course objective
Graduates will be successful as engineers in the industry and provide solutions to problems faced in the multi-disciplinary field of Automation & Robotics. Graduates will have the ability to be an integral part of research program and involve in a process of lifelong learning. Graduates will address problems in the society in a professional & ethical manner with due attention to environmental issues.

Particulars

Unit 1

Unit 2

Unit 3

Unit 4
Unit 5


References
5. An Introduction to Automated Process Planning Systems- Tiess Chiu Chang & Richard A. Wysk

Course Outcome
After the successful completion of this course, the student will be able:

CO1: To identify potential areas for automation and justify need for automation
CO2: To select suitable major control components required to automate a process or an activity
CO3: To translate and simulate a real time activity using modern tools and discuss the benefits of automation.
CO4: To explain the basic principles of Robotic technology, configurations, control and programming of Robots.
CO5: To choose the appropriate Sensor and Machine vision system for a given application.
Syllabus

Material Characterization (PET – 318)

L T P: 3 0 0 Credits-3

Course objective
The course provides an overview of materials characterization.

Particulars

Unit 1:
Light Microscopy: Introduction, concept of resolution, Airy rings, numerical aperture, magnification, depth of field, depth of focus, lens defects and their corrections, principles of phase contrast – bright-field and dark-field contrast, polarized light microscopy, Quantitative microscopy, estimation of grain size, grain boundary area, relevance of light microscopy ideas to electron microscopy.

Unit 2:

Unit 3:
Transmission electron microscopy (TEM): Principle, construction and operation of TEM, Interaction of electrons with specimen, reciprocal space and lattice, Ewald sphere, diffraction from finite crystal, preparation of specimens, bright and dark field imaging, selected area diffraction, indexing of diffraction patterns.

Unit 4:
Scanning electron microscopy (SEM): Principle, construction and operation of SEM, study of fractured surfaces, energy and wavelength dispersive spectroscopy.

Unit 5:
Thermal analysis techniques: Principles of differential scanning calorimetry (DSC), differential thermal analysis (DTA), Dilatometry, Thermogravimetric analysis (TGA).

Additional techniques: emission spectroscopy, Atomic Absorption Spectroscopy, Inductively Coupled Plasma - Mass Spectroscopy (ICP-MS), Vibrating Sample Magnometer (VSM), SQUID, four probe resistivity measurement.
References


Course Outcomes

CO1: Able to understand basics of microscopy.
CO2: Able to understand basics of X-ray diffractometry.
CO3: Able to understand basics of transmission electron microscopy.
CO4: Able to understand basics of scanning electron microscopy.
CO5: Able to understand basics of thermal analysis techniques and additional techniques.
Syllabus

Metal Casting (PET – 319)

L T P: 3 0 0

Course objective
To inculcate the principle, thermal and metallurgical aspect during solidification of metal and alloys. To impart knowledge about principles methods of casting with detail design of gating & riser system needed for casting, defects in cast object and requirements for achieving sound casting.

Particulars

Unit 1
Introduction: Features of Casting problems, Survey and Scope of Foundry Industries, Solidification of pure metals, Nucleation and growth in alloys, Solidification of actual casting, Progressive and directional solidification, Centreline feeding resistance, Rate of solidification, Chvorinov’s rule, Electrical analog of solidification problems.

Unit 2
Gating and Risering Systems: Gating systems and their characteristics, Effects of gates on aspiration, Turbulence and dross trap, recent trends, Riser design, Risering curves, NRL method of riser design, Feeding distance, Risering of complex casting, Risering of alloys other than steel, Riser design by geometrical programming.

Unit 3
Moulding and Core Making: Review and critical comparison of various established processes, recent developments example low pressure and ferrous die casting, High pressure moulding, Full mould process, Flasklessmoulding, Hot and cold box moulding, Ceramic shell moulding, V-process, Continuous casting, Squeeze and pressed casting, Nishiyama process, Shaw process, Anitoch process.

Melting and Fluidity: Selection and control of melting furnaces; melting, refining and pouring; Coupla design, Measurement of fluidity, Effect of various parameters on fluidity, Methods of elimination and control of gases in casting.
Unit 4

**Internal Stress, Defects and Surface Finish:** Residual stresses, Hot tears and cracks in casting; Stress relief, defects and their causes and remedies; Parameters affecting surface finish and related defects e.g., Rough casting, bum-on sand bum-in metal penetration, Facing and washes; Mold wall movement; transport zones, Expansion scabbing etc.

Unit 5

**Casting of Sand, Design Considerations:** Recent developments, e.g., Mulling index; Mouldability index, Compatibility, deformability etc.

**Foundry Practice:** Casting of different Cast Irons, Steel, Aluminum, Zinc, Brass etc., Mechanization in Foundry, Use of Computers in foundry, Inspection and Quality Control-Review of X-ray and gamma ray radiography, Magnetic particle, Penetrant and Ultrasonic inspections, use of statistical quality control.

References

2. Fine Art Metal Casting by Richard Rome.

Course Outcomes

**CO1:** Able to explain the principle, thermal and metallurgical aspect during solidification of metal and alloys. **CO2:** Able to explain about methods of casting with detail design of gating & riser system needed for casting.

**CO3:** Able to explain the different defects in cast object and requirements for achieving sound casting.

**CO4:** Able to explain the different recent trends in the metal casting.

**CO5:** Able to explain the casting of different materials like cast iron, iron alloys and other materials.
Syllabus

Machine Tool Design (PET – 320)

L T P: 3 0 0

Credits: 3

Course objective

To impart the clear knowledge about the machine tool design.

Particulars

Unit 1


Unit 2

Regulation of Speed and Feed Rates: Aim of speed feed regulation, stepped regulation of speed, design of speed box, Design of feed box, Special cases of gear box design, Set stopped regulation of speed and feed rates.

Unit 3


Unit 4


Design of Spindles and Spindle Supports: Materials for spindles, Design of spindles, Antifriction bearings, Sliding bearings.

Unit 5

Dynamics of Machines Tools: General procedure of assessing dynamic stability of EES, Cutting processing, closed loop system, Dynamic characteristics of cutting process, Stability analysis.
References


Course Outcomes

CO1: The students will able to explain the Auxiliary motion, feed motion of different machine tool, layout of machine, and general requirement of machine tool.

CO2: The student will be able to design the speed box and feed box.

CO3: The student will be able to design various parts of machine tool like bed, column, housing, etc.

CO4: The student will be able to design guideways, spindle and spindles support of a machine tool.

CO5: The student will be able to assess dynamic stability of EES and Dynamic characteristics of cutting process, Stability analysis.
Syllabus

Waste to Energy(PET – 331)

L T P: 3 0 0

Course objective
The course deals with the production of energy from different types of wastes through thermal, biological and chemical routes. It is intended to help the young scientist professionals to keep their knowledge upgraded with the current thoughts and newer technology options along with their advances in the field of the utilization of different types of wastes for energy production.

Particulars

Unit 1
Introduction to energy from waste: characterization and classification of waste as fuel – Agrobased, characterization of wastes, forest residues, industrial waste, Municipal solid waste.

Unit 2
Waste to energy options: Energy production form wastes through incineration, combustion (unprocessed and processed fuel), gasification, anaerobic digestion, fermentation, pyrolysis, Energy production from wastes through fermentation and transesterification.

Unit 3
Conversion devices: Combustors (Spreader Stokes, Moving grate type, fluidized bed), gasifier, digesters. Briqueting technology: Production of RDF and briquetted fuel. Properties of fuels derived from waste to energy technology: Producer gas, Biogas, Ethanol and Briquettes, Comparison of properties with conventional fuels.

Unit 4
Energy production from organic wastes through anaerobic digestion and fermentation, Introduction to microbial fuel cells, Densifications of solids, efficiency improvement of power plant and energy production from waste plastics.

Unit 5
Power generation using waste to energy technologies: CI and SI engines, IGCC and IPCC concepts, Landfills: Gas generation and collection in landfills, Environmental monitoring system for land fill gases, Environmental impacts; Measures to mitigate environmental effects due to incineration, Introduction to transfer stations.
References


Course Outcomes

At the end of this course, the student is able to

CO1: Define and explain important concepts in the field of waste management, such as waste hierarchy, waste prevention, recirculation, municipal solid waste etc.

CO2: Suggest and describe suitable technical solutions for biological and thermal treatment of the waste. The student should also be able to discuss the drawbacks and prerequisites for a chosen solution.

CO3: Formulate protocol to convert agricultural waste into energy also discuss the various techniques to describe the waste to energy conversion system.

CO4: Discuss social aspects connected to handling and recirculation of waste from a local as well as global perspective.

CO5: Analyze and describe the potential as a secondary raw material, and thereby associated problems.
Syllabus

Cost Management of Engineering Projects (PET – 332)

L T P: 3 0 0

Credits-3

Course objective
Students will be able to understand the tools of costing and managerial aspect to implement an engineering project.

Particulars


Unit 2: 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 non-technical 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. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process.


References

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

**Course Outcomes**

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

**CO1:** understand the aspect of costing aspects in decision making and inventory.

**CO2:** perceived knowledge of project execution.

**CO3:** understand the cost behaviour and profit planning marginal costing.

**CO4:** understand the aspect of MRP, ERP and TQM.

**CO5:** analyse the quantitative techniques for cost management.
Syllabus

Industrial Safety (PET – 333)

L T P: 3 0 0 Credits-3

Course objective
Students will be able to recognize and evaluate occupational safety and health hazards in the workplace, and to determine appropriate hazard controls following the hierarchy of controls. Students will furthermore be able to analyze the effects of workplace exposures, injuries and illnesses, fatalities and the methods to prevent incidents using the hierarchy of controls, effective safety and health management systems and task-oriented training.

Particulars

Unit 1

Industrial safety: 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 2

Fundamentals of maintenance engineering: 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 3


Unit 4

Fault tracing: 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

Unit 5


References


Course Outcomes

At the end of this course, the student is able to

CO1: Evaluate workplace to determine the existence of occupational safety and health hazards. Also describes the different safety considerations.

CO2: Identify the scope of maintenance engineering along with best practices that are applicable.

CO3: Understand the wear and corrosion analysis of different industrial equipment and various types of maintenance.

CO4: Analyse the fault tracing-concept and importance of decision tree concept. Also study about the different industrial equipment.

CO5: To understand the periodic and preventive maintenance to avoid the industrial hazards.
Syllabus

Operation Research (PET – 334)

L T P: 3 0 0 Credits-3

Course objective

The course provides an overview of operation research.

Particulars

Unit 1


Unit 2

Nonlinear programming: Kuhn- Tucker conditions- quadratic programming- Wolfe's algorithm.

Decision Theory: Introduction, Decision under certainty, Decision under risk, Decision under uncertainty, Laplace criterion, MaxiMin criterion, MiniMax criterion, savage MiniMax regret criterion, hurwicz criterion, Decision tree.

Unit 3

Game Theory: Formulation of games, two person-Zero sum game, games with and without saddle point, Graphical solution (2x n, m x 2 game), dominance property, mixed strategy (3x3 or higher games).

Introduction to optimization techniques, sequencing and scheduling, sensitivity analysis.

Unit 4

Dynamic Programming: Deterministic and stochastic example.

Goal Programming: Formulations Goal Programming Solutions Complexity of Simplex Algorithm.

Unit 5

PERT-CPM Techniques: Network construction, determining critical path, floats, scheduling by network, project duration, variance under probabilistic models, prediction of date of completion.
References


Course Outcomes

CO1: Able to understand the basics of OR and LPP.
CO2: Able to understand and solve the nonlinear programming problems and decision theory.
CO3: Able to understand and analyse game theory problems.
CO4: Able to understand and analyse dynamic and goal programming.
CO5: Able to understand and analyse PERT and CPM techniques.
Syllabus

Composite Materials(PET – 335)

L T P: 3 0 0

Credits-3

Course objective
To learn about different types of composite materials and their applications. To understand the concept of composite fabrication and techniques. To evaluate the performance of various types of composite materials.

Unit 1: Introduction

Unit 2: Reinforcements
Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particlereinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures, Isostrain and Isostress conditions.

Unit 3: Manufacturing of Metal Matrix Composites

Unit 4: Manufacturing of Polymer Matrix Composites

Unit 5: Strength
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.
References
3. DrNavin Chand, Tribology of Natural fiber Composites, Wood Head Publishing Limited, Eng.

Course Outcomes
CO1: To be able to understand the concept of composite materials and their classification.
CO2: To be able to understand the different types of reinforcements.
CO3: To be able to understand the various techniques of metal matrix composite fabrication techniques.
CO4: To be able to understand the various techniques of polymer composite fabrication techniques.
CO5: Understand the analysis of strength criteria of composites.
Syllabus

Industrial Design and Ergonomics (PET – 336)

L T P: 3 0 0 Credits-3

Course objective
The aim of this course is to acquaint students with basics of industrial and ergonomics.

Particulars

Unit 1
Introduction to Ergonomics and Industrial Design: An approach to industrial design- elements of design, Structure for industrial design in engineering; Application in modern manufacturing systems; General approach to the man-machine relationship, Work station design, Working position.

Unit 2
Control and Displays: Shapes and sizes of various controls and displays- Multiple displays and controlsituations; design of major controls in automobiles, machine tools etc.; Design of furniture; Redesign ofinstruments.

Unit 3
Ergonomics and Production: Ergonomics and product design, ergonomics in automated systems; Expert systems for ergonomic design; Anthropometrics data and its applications in ergonomic design; Limitations of anthropometric data, Use of computerized database; Case study.

Unit 4
Visual Effects of Line and Colour: The mechanics of seeing; Psychology of seeing; General influence of line and form; Colour and light; Colour and objects; Colour and the eye; Colour consistency; Colour terms; Reaction to colour and colour continuation; Colour on engineering equipment’s.

Unit 5:
Aesthetic Concepts: Concept of unity; Concept of order with variety; Concept of purpose style and environment; Aesthetic expressions; Style, Components of style; House style; Observation style in capital goods; Case study.

References
1. Industrial design for Engineers W.H. Mayall London Hifice Books Ltd.
2. Introduction to Ergonomics R.C. Bridger McGraw Hill.
3. Human Factor Engineering Sanders & McComlick.
Course Outcomes

At the end of this course, the student is able to

CO1: Understand the aspect and importance of industrial design and ergonomics.
CO2: Understand the importance of controls and displays.
CO3: Understand the importance of ergonomics in production system.
CO4: Understand the importance of visual effects of line and colour.
CO5: Understand the aesthetic concept.