COURSE CURRICULUM AND EVALUATION SCHEME

M. Tech. Production Engineering

(w.e.f. session 2018-19)

G. B. Pant Institute of Engineering and Technology,

Ghurdauri, Pauri Garhwal (Uttarakhand), 246194

1st Year Scheme and Syllabus

COURSES AND EVALUATION SCHEME
YEAR I, SEMESTER I
(M. Tech. Production Engineering)
(Effective from session: 2018-19)

S. No.	COURSE CODE	SUBJECT	PERIODS			EVALUATION SCHEME					
						SESSIONAL EXAM			ESE	Subject Total	Credits
			L	T	P	CT	TA	Total			
THEORY											
1.	TPE-511	Machining Science	3	1	0	40	40	80	120	200	4
2.	TPE-512	Industrial Tribology	3	1	0	40	40	80	120	200	4
3.	EPE-51X	Elective-I	3	1	0	40	40	80	120	200	4
4.	EPE-51X	Elective-II	3	1	0	40	40	80	120	200	4
5.	TRM-511	Research Methodology and IPR	2	0	0	20	20	40	60	100	2
6.	TAC-51X	Audit Course-I*	2	0	0	20	20	40	60	100	0
PRACTICAL											
7.	PPE-511	Machining Science Lab	0	0	2	10	15	25	25	50	1
8.	PPE-512	Industrial Tribology Lab	0	0	2	10	15	25	25	50	1
9.	GPP-511	General Proficiency*	0	0	0	0	50	50	0	50	0
SEMESTER TOTAL			**16**	**4**	**4**	**200**	**210**	**410**	**590**	**1000**	**20**

List of Electives

Elective I:

1. EPE-510 Computational Methods in Engineering
2. EPE-511 Micro Electro Mechanical Systems
3. EPE-512 Modelling and Simulation
4. EPE-513 Facility planning and Value Engineering

Elective II:

1. EPE-514 Machine Tool Design
2. EPE-515 Materials Managements
3. EPE-516 Computer Aided Process Planning
4. EPE-517 Rapid Prototyping and Tooling

Audit course-I

1. TAC-511 English for Research Paper Writing
2. TAC-512 Sanskrit for Technical Knowledge
3. TAC-513 Value Education
4. TAC-514 Constitution of India

Machining science

TPE – 511 L T P: 3 1 0

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

Micro-milling Tools, Process Results and Micro-milling Applications- micromechanically milled X-ray masks, micro-milled mask materials, Mask Absorption, Quantification, and Exposure Quantification. Microdrilling: Micro-drilling and Macro-drilling Techniques.

References

1. E. J. A. Armarego, R. H. Brown, “The Machining of Metals”, Prentice Hall Inc.
2. Kronenberg, “Machining Science and Applications”, Pergamon Press.

3. Geoffrey Boothroyd and W. A. Knight, “Fundamentals of Machining and Machine Tools”,MarcelDekkel Inc.
4. J. A. McGeough, “Advanced Methods of Machining”, Chapman and Hall.
5. P. L. B. Oxley, “The Mechanics of Machining”, Ellis Horwood Ltd.
6. Gary F. Benedict, “Nontraditional Manufacturing Processes”, Marcel Dekker Inc.
7. Amitabha Battacharyya, “Metal Cutting, Theory and Practice”, New Central Book Agency
8. Amitabh Ghosh and Asok Kumar Mallik, “Manufacturing Science”, Affiliated East West Press Pvt. Ltd.
9. B. L. Juneja and G.S. Sekhon, “Fundamentals of Metal Cutting and Machine Tools”, New Age, International (P) Ltd.
10. V. C. Vekatesh and H. Chandrasekharan, “Experimental Techniques in Metal cutting”, Practice Hall of India Pvt. Ltd.
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.

Industrial tribology

TPE – 512 L T P: 3 1 0

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
4. Tribology Handbook M.J. Neele.

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.

Machining Science Lab

PPE – 511 L T P: 0 0 2

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

1. E. J. A. Armarego, R. H. Brown, "The Machining of Metals", Prentice Hall Inc.
2. Kronenberg, "Machining Science and Applications", Pergamon Press.
3. Geoffrey Boothroyd and W. A. Knight, "Fundamentals of Machining and Machine Tools",MarcelDekkel Inc.
4. J. A. McGeough, "Advanced Methods of Machining", Chapman and Hall.
5. P. L. B. Oxley, "The Mechanics of Machining", Ellis Horwood Ltd.
6. Gary F. Benedict, "Nontraditional Manufacturing Processes", Marcel Dekker Inc.
7. Amitabha Battacharyya, "Metal Cutting, Theory and Practice", New Central Book Agency
8. Amitabh Ghosh and Asok Kumar Mallik, "Manufacturing Science", Affiliated East West Press Pvt. Ltd.
9. B. L. Juneja and G.S. Sekhon, "Fundamentals of Metal Cutting and Machine Tools", New Age, International (P) Ltd.
10. V. C. Vekatesh and H. Chandrasekharan, "Experimental Techniques in Metal cutting", Practice Hall of India Pvt. Ltd.

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.

Industrial Tribology Lab

PPE – 512 L T P: 0 0 2

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.
2. Principles and Applications of Tribology D.F. Moore Pergamon Press.
3. Fundamentals of Tribology Basu, Sengupta & Ahuja Prentice Hall of India.
4. Tribology Handbook M.J. Neele.

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 principal of erosion.

CO5: Ability to understand the application of industrial tribology.

Computational Methods in Engineering

EPE-510 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

Bisection method, Regula-Falsi method, Secant method, Newton-Raphson method, Multiple roots by Newton's method, Graeffe's root squaring method, Comparison of iterative methods.

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

Euler's Method, Modified Euler's method, Runge-Kutta method: second order, third order and fourth order, Milne's Predictor-Corrector method, Solution of simultaneous first order differential equations: Picard's method and Runge-Kutta method, Finite Difference method, Solution of Laplace equation by Liebman's method.

References

1. Numerical Methods by Sukhendu Dey and Shishir Gupta, Mc-Graw Hill
2. Numerical Methods by B.S. Grewal, Khanna Publications
3. Numerical Method for Scientific and Engineering Computation by M.K. Jain, S.R.K. Iyenger and R.K.

Jain, Wiley Eastern Ltd.

4. Numerical Methods by A.D. Booth, Academic Press, NY
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
7. Elementary Numerical Analysis by S.D. Conte, McGraw Hill
8. Numerical Methods for Engineers by S.K. Gupta, Wiley Eastern Ltd.

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.

Micro-electro mechanical systems

EPE – 511 L T P: 3 0 0

Course objective

To educate on the rudiments of micro fabrication techniques and to introduce different types of sensors and actuators. Moreover, the micro systems design are also explored.

Particulars

Unit 1

Overview of MEMS and Microsystems: MEMS and Microsystems, Microsystems and Microelectronics, Microsystems and miniaturization, Application of Microsystem. Working Principles of Microsystem: Microsensors- Acoustic wave sensors, biomedical sensors and bio sensors, chemical sensors, optical sensors, pressure sensors, thermal sensors. Micro actuation- actuation using thermal forces, actuation using shape-memory alloys, actuation using piezoelectric crystals, actuation using electrostatic forces. MEMS and Micro actuators- Micro grippers, micromotors, microvalves, micropumps, micro accelerometers, Microfluidics.

Unit 2

Materials for MEMS and Microsystems: substrates and wafers, active substrate materials, silicon as a substrate material- the ideal substrate for MEMS, single crystal silicon and wafers, crystal structure, the miller indices, mechanical properties of silicon. Silicon compounds- silicon dioxide, silicon carbide, silicon nitride, polycrystalline silicon piezo resistors, Gallium arsenide, polymers for MEMS and Microsystems, conductive polymer, the Langmuir-Blodgett film, packaging materials.

Unit 3

Microsystems Fabrication Processes: Photolithography-photo resists and application, light sources, photo resist development, photo resist removal and post baking. Ion implantation, diffusion, oxidation-thermal oxidation, silicon dioxide, thermal oxidation rates, oxide thickness by color; Chemical vapor deposition-working principle of CVD, chemical reaction s in CVD, rate of deposition, enhanced deposition; physical vapor deposition- sputtering; Deposition by epitaxy; Etching- Chemical etching, plasma etching.

Unit 4

Micro manufacturing: Bulk Manufacturing- overview of etching, isotropic and anisotropic etching, wet etchants; etch stop, dry etching, and comparison of wet versus dry etching. Surface micromachining- general description, process in general, mechanical problems associated with surface micromachining. The LIGA Process- general description of the LIGA process, materials for substrates and photo resists, electroplating. The SLIGA process.

Unit 5

Microsystems Design: Design Considerations- Design constraints, selection of materials, selection of manufacturing processes, selection of signal transduction, electromechanical system and packaging

Process design- photolithography, thin film fabrications, geometry shaping, Mechanical design- thermo mechanical loading, thermo mechanical stress analysis, dynamic analysis, interfacial fracture analysis. Design of micro fluidic network systems- fluid resistance in microchannels, capillary electrophoresis network systems, mathematical modeling of capillary electrophoresis network systems

References

1. MEMS & Microsystems Design and Manufacture by Tai-Ran Hsu Tata McGraw-Hill
2. Pelesko, J.A., and Bernstein D.H., "Modeling MEMS and NEMS", 1st Ed., Chapman and Hall CRC
3. Beeby, S., Ensell, G., Kraft, M., and White N., "MEMS Mechanical Sensors", 1st Ed., Artech House, Inc.
4. Bao, M., "Analysis and Design Principles of MEMS Devices", 1st Ed., Elsevier B.V.
5. Mohamed Gad-el-Hak (Editor), "The MEMS Handbook", 2nd Ed., Taylor and Francis.
6. Adams, T.M., and Layton, R.A., "Introductory MEMS: Fabrication and Applications", Springer New York.

Course outcomes

At the end of course, student will able to

CO1: describe new applications and directions of modern engineering.

CO2: illustrate the techniques for building microdevices in silicon, polymer, metal and other materials.

CO3: demonstrate the physical, chemical, biological, and engineering principles involved in the design and operation of current and future microdevices.

CO4: critically analyze microsystems technology for technical feasibility as well as practicality.

CO5: outline the limitations and current challenges in microsystems technology.

Modeling and simulation

EPE – 512 L T P: 3 1 0

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

1. Banks, J., Nelson, B.L., Carson, J. S., and Nicol, D., “Discrete Event System Simulation”, Pearson Education
2. Law, A.M., and Kelton, W.D., “Simulation Modeling and Analysis”, McGraw-Hill
3. Schwarzenbach, J., and Gill, K.F., “System Modeling and Control”, Butterworth-Heinemann
4. Carrie, A., “Simulation of Manufacturing Systems”, John Wiley & Sons
5. Viswanadham, N., and Narahari, Y., “Performance Modeling of Automated Manufacturing System”, Prentice-Hall of India.

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.

Facility planning and value engineering

EPE – 513 L T P: 3 0 0

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 Bridgemannn'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

1. Tompkins, J. A., White, J. A., Bozer, Y.A. and Tanchoco, J.M.A., Facilities Planning, John Wiley (2003).

2. Muther, R., Practical Plant Layout, McGraw Hill Book Company (1995).
3. Anil Kumar Mukhopadhyaya, "Value Engineering: Concepts Techniques and applications", SAGE Publications 2010.

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.

Machine Tool Design

EPE – 514 L T P: 3 1 0

Course objective

To impart the clear knowledge about the machine tool design.

Particulars

Unit 1

Machine Tool Drive: working and auxiliary motion in machine, Machine tool drives, Hydraulic transmission, Mechanical transmission, General requirements of machine tool design, Layout of machine tools.

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

Design of Machine Tool Structure: Fundamentals of machine tool structures and their requirements, Design criteria of machine tool structure, Static and dynamic stiffness, Design of beds and columns, Design of housing models, Techniques in design of machine tool structure.

Unit 4

Design of Guide-ways and power Screws: Function and type of guide-ways, design of slide-ways, protecting devices for slide-ways, Design of power screws.

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

1. N.K. Mehta, Machine Tool Design and Numerical Control, TMH, New Delhi, 2010.
2. G.C. Sen and A. Bhattacharya, Principles of Machine Tools, New Central Book Agency, 2009.
3. D. K Pal, S. K. Basu, “Design of Machine Tools”, 5th Edition. Oxford IBH, 2008.
4. N. S. Acherkhan, “Machine Tool Design”, Vol. I, II, III and IV, MIR publications, 1968.

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.

Materials Management

EPE – 515 L T P: 3 1 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

1. Gopalakrishnan. P, “Purchasing and Materials Management”, Tata McGraw Hill, 1990.
2. Learnerr Lee Jr. and Donald. M. Dobbler, "Purchasing and Material Management”, Tata McGraw Hill, 1996.
3. Camer Lee and Donald M Dubbler, “Purchasing and Materials Management, Text and cases”, Tata McGraw Hill, 1997.
4. Mark. J.V, “Operations Management”, McGraw Hill Publishers, 1984.

5. Westing. J.K, Fine, E.V. and Zone. C.T, "Purchasing Management Principles", John Wiley & Sons, New York, 1986.

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.

Computer Aided Process Planning

EPE – 516 L T P: 3 1 0

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

1. Chang, T. C. and Wysk, R. A, "An Introduction to Automated Process Planning", Prentice-Hall.
2. Gallagher, C. C and Knight, W. A., "Group Technology: Production Method in Manufacturing", Ellis Horewood.
3. Nilsson, N. J., "Principles of Artificial Intelligence", Springer Verlag.
4. Cornelius, L.T, "Computer Aided and Integrated Manufacturing Systems: Manufacturing Processes", World Scientific Publishing Company.

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.

Rapid Prototyping and Tooling

EPE – 517 L T P: 3 1 0

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, Soligen Diren'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:

1. Rapid Prototyping of Digital Systems: A Tutorial Approach by Hamblen James O Kluwer.

2. Rapid Prototyping: Principles and Applications by Kai Chua Chee, World Science.
3. Rapid System Prototyping: Accelerating the Design Process by R C Cofer.
4. Rapid Prototyping of Digital Systems by James O Hamblen Springer.

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.

Research Methodology and IPR

TRM – 511 L T P: 2 0 0

Course objective

The Course aims to provide conceptual knowledge of Research Methodology and Intellectual Property Rights.

Particulars

Unit 1: Introduction & Overview

Meaning of research, objectives, Motivation in research, types of research, research methods vs. Methodology, Research process, criteria of good research, problems encountered by researchers in India.

Unit 2: Defining Research Problem and Data Collection

Defining and selecting the problem, necessity of defining problem, techniques involved in defining a problem, research design, and features of a good design. Primary and secondary data, methods of data collection and interpretation, Concept and need for sampling.

Unit 3: Effective Technical Writing

Meaning of report writing, how to write a report (Steps), Types of reports, Developing a research proposal, its assessment and presentation. Computer and its role in research.

Unit 4: Intellectual Property Rights

Definition, nature of IPR, Patent, designs, trade and copyrights. Process of patenting and development. Indian Patent process system. Reasons for formation of GATT and WIPO and role of GATT and WIPO, Patenting under PCT.

Unit 5: Patent Rights

Definition, scope of patent rights, Licensing and transfer of technology, Geographical indications, New developments in IPR.

References

1. Ranjit Kumar 2nd edition, Research Methodology, Sage Publications
2. C.R. Kothari 2nd edition Research Methodology, New age Publications
3. Halbert, Resisting Intellectual Property, taylor and Francis
4. T. Ramappa, IPR under W.T.O. S. Chad, 2008

Course Outcomes

CO-1: Ability to understand the research problem formulation.

CO-2: Emphasis on analyzing research related information

CO-3: Ability to write an effective report.

CO-4: To understand the value of IPR's in growth of individuals and nation.

CO-5: To understand that IPR protection is a mean to Product and individual betterment.

COURSES AND EVALUATION SCHEME
YEAR I, SEMESTER II
(M. Tech. Production Engineering)
(Effective from session: 2018-19)

S. No.	COURSE CODE	SUBJECT	PERIODS			EVALUATION SCHEME					
						SESSIONAL EXAM			ESE	Subject Total	Credits
			L	T	P	CT	TA	Total			
THEORY											
1.	TPE-521	Advanced Welding Technology	3	1	0	40	40	80	120	200	4
2.	TPE-522	Computer Integrated Manufacturing	3	1	0	40	40	80	120	200	4
3.	EPE-52X	Elective III	3	1	0	40	40	80	120	200	4
4.	EPE-52X	Elective IV	3	1	0	40	40	80	120	200	4
5.	TAC-52X	Audit Course-II*	2	0	0	20	20	40	60	100	0
PRACTICAL											
6.	PPE-521	Advanced Welding Technology Lab	0	0	2	10	15	25	25	50	1
7.	PPE-522	Computer Integrated Manufacturing Lab	0	0	2	10	15	25	25	50	1
8.	PPE-523	Mini Project	0	0	4	20	30	50	50	100	2
9.	GPP-521	General Proficiency*	0	0	0	0	50	50	0	50	0
SEMESTER TOTAL			**14**	**4**	**8**	**200**	**220**	**420**	**580**	**1000**	**20**

List of Electives

Elective III:

1. EPE-520 Optimization Techniques
2. EPE-521 Industrial Automation and Robotics
3. EPE-522 Advanced Manufacturing Processes
4. EPE-523 Finite Element Methods
5. EPE-524 Industrial Design and Ergonomics

Elective IV:

1. EPE-525 Supply Chain Management
2. EPE-526 Material Characterization
3. EPE-527 Automated Material Handling System
4. EPE-528 Metrology and Inspection
5. EPE-529 Metal Casting

Audit course-II

1. TAC-521 Disaster Management
2. TAC-522 Pedagogy Studies
3. TAC-523 Stress Management by Yoga
4. TAC-524 Personality Development through Life Enlightenment Skills

Advanced Welding Technology

TPE – 521 L T P: 3 1 0

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

Heat Flow: Heat Source Efficiency, Heat Source Efficiencies in Various Welding Processes, Melting Efficiency, Temperature distribution due to heat flow in Arc Welding, Metallurgical effects of Heat flow in welding, Time-Temperature-Transformation Diagrams (TTT Curves), Continuous Cooling Transformation Diagrams (CCT Curves)

Gas-Metal Reactions, Slag-metal Reactions,

Unit 4

Welding Metallurgy and Weldability:

Heat affected zone and its properties; Heat treatment in fusion welding, Microstructural products in weldments, Effects of alloying elements on microstructure, Weld defects. Weldability of metals and alloys: weldability of steels, stainless steel, cast iron, and aluminum and titanium alloys.

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
3. Metallurgy of welding – J. F. Lancaster, George Alien &Unwin Publishers
4. Welding Metallurgy – Sindo Kou, John Wiley & Sons, Inc., Publication
5. ASM Handbook vol.6, welding Brazing & Soldering
6. Advanced Welding Processes-John Norrish, Woodhead Publishing Ltd Cambridge

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.

Computer Integrated Manufacturing

TPE – 522 L T P: 3 1 0

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:

Numerical Control: Introduction- Fundamentals of N. C. Technology, Computer Numerical Controls, Distributed Numerical Control, Application of N.C., Engineering analysis of NC positioning system, N.C. part programming, part programming with APT.

Unit 3:

Group Technology: Introduction, Basic layout, process layout, product layout, comparison. Designing process layout. Coding system.

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

1. Groover M P, Automation, Production Systems, and Computer-Integrated Manufacturing, PHI Learning Pvt. Ltd.
2. Alavudeen A &Venkateshwaran N., Computer Integrated Manufacturing, PHI Learning Pvt. Ltd.
3. Cornelius,L.T, "Computer Aided and Integrated Manufacturing Systems: Manufacturing Processes", World Scientific Publishing Company.
4. Chang,T.-C., Wysk,R. A. and Wang, H.-P. "Computer Aided Manufacturing", 3rd Ed., Prentice Hall.

5. Rao,P. N., Tiwari,N. K. and Kundra,T.K., “Computer Aided Manufacturing”, Tata McGraw Hill.
6. Sava,M. and Pusztai,J., “Computer Numerical Control Programming”, Prentice Hall.

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.

Advanced Welding Technology Lab

PPE – 521 L T P: 0 0 2

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
3. Metallurgy of welding – J. F. Lancaster, George Alien &Unwin Publishers
4. Welding Metallurgy – Sindo Kou, John Wiley & Sons, Inc., Publication
5. ASM Handbook vol.6, welding Brazing & Soldering
6. Advanced Welding Processes-John Norrish, Woodhead Publishing Ltd Cambridge

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 weldings.

Computer Integrated Manufacturing Lab

PPE – 522 L T P: 0 0 2

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 "GBPIET" 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

1. Groover M P, Automation, Production Systems, and Computer-Integrated Manufacturing, PHI Learning Pvt. Ltd.
2. Alavudeen A &Venkateshwaran N., Computer Integrated Manufacturing, PHI Learning Pvt. Ltd.
3. Cornelius,L.T, "Computer Aided and Integrated Manufacturing Systems: Manufacturing Processes", World Scientific Publishing Company.
4. Chang,T.-C., Wysk,R. A. and Wang, H.-P. "Computer Aided Manufacturing", 3rd Ed., Prentice Hall.
5. Rao,P. N., Tiwari,N. K. and Kundra,T.K., "Computer Aided Manufacturing", Tata McGraw Hill.
6. Sava,M. and Pusztai,J., "Computer Numerical Control Programming", Prentice Hall.

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.

Optimization Techniques

EPE – 520 L T P: 3 1 0

Course objective

To introduce different optimization algorithm concepts with the help of numerical examples in a simple manner without sacrificing accuracy. This course also covers newly developed methods of optimization, such as genetic algorithm, neural network and simulated annealing.

Particulars

Unit 1: Introduction to Optimization

Historical Developments, engineering applications of Optimization.

Classical Optimization Techniques: Introduction, Single and multivariable optimization methods with and without constraints, linear programming – simplex, dual simplex method.

Unit 2: Unconstrained Optimization

Introduction – Linear or nonlinear, Direct search method – Random, Univariate and Pattern search methods, Indirect Methods – Steepest Descent method, Quasi – Newton's and Variable Metric methods.

Unit 3: Constrained Optimization

Introduction, Direct methods – Cutting plane method, Method of feasible directions,

Indirect methods – Convex programming problems, Exterior penalty method, Interior penalty method.

Unit 4: Other Methods of Optimization

Geometric Programming – Introduction, Unconstrained minimization problems, Constrained minimization problems.

Dynamic Programming – Introduction, Multistage Decision Processes, Concept of sub-optimization and principle of Optimality.

Integer Programming – Introduction, Integer Linear Programming, Integer Nonlinear Programming, Branch and bound algorithm.

Unit 5: Novel Methods of Optimization

Introduction, Multi-objective Optimization, Genetic Algorithm, Design of GA, Simulated Annealing, Selection of simulated annealing parameters, Neural Network, A frame work for neural network, construction of Neural Network algorithm.

References

1. Engineering Optimization by S.S. Rao, New Age International.
2. Optimization for Engineering Design by Kayanmoy Deb, Prentice Hall of India.
3. Applied Optimal Design by E.J. Haug and J.S. Arora, Wiley New York.

4. Optimization by G.V. Reklaties, A Ravindran and K.M. Rogsdeth, Wiley, New York.
5. Linear Programming by G. Hadley, Narosa Publishing House, New Delhi.
6. K. Srinivasa Raju and D. Nagesh Kumar, Multicriterion Analysis in Engineering and Management, PHI Learning private limited, New Delhi.

Course outcomes

CO1: Define and use optimization terminology and concepts, and understand to develop and apply various optimization methods to solve a model.

CO2: Understand and apply unconstrained optimization theory for continuous problems.

CO3: Understand and apply constrained optimization theory for continuous problems.

CO4: Understand and apply methods for dynamic, geometric and integer programming problems.

CO5: Understand the basics of Heuristic and Novel approach of Optimization.

Industrial Automation and Robotics

EPE – 521 L T P: 3 1 0

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 programmes 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

Introduction: Automation and Robotics, Historical Development, Automation in Production System, Principles and Strategies of Automation, Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automations. Flow lines & Transfer Mechanisms, Fundamentals of Transfer Lines.

Unit 2

Material handling and Identification Technologies: Overview of Material Handling Systems, Principles and Design Consideration, Material Transport Systems, Storage Systems, Overview of Automatic Identification Methods.

Unit 3

Automated Manufacturing Systems: Components, Classification and Overview of Manufacturing Systems, Manufacturing Cells, GT and Cellular Manufacturing, FMS, FMS and its Planning and Implementation. Quality Control Systems: Traditional and Modern Quality Control Methods, SPC Tools, Inspection Principles and Practices, Inspection Technologies.

Unit 4

Robotics: Robotics Historical Development, Definitions, Basic Structure of Robots, Robot Anatomy, Complete Classification of Robots, Fundamentals about Robot Technology, Factors related to use Robot Performance, Basic Robot Configurations and their Relative Merits and Demerits, the Wrist & Gripper Subassemblies. Concepts about Basic Control System, Control Loops of Robotic Systems, Different Types of Controllers- Proportional, Integral, Differential, PID controllers.

Unit 5

Robot Sensing & Vision: Various Sensors and their Classification, Use of Sensors and Sensor Based System in Robotics, Machine Vision System, Description, Sensing, Digitizing, Image Processing and Analysis and Application of Machine Vision System, Robotic Assembly Sensors and Intelligent Sensors.

Industrial Applications: Objectives, Automation in Manufacturing, Robot Application in Industry, Task Programming, Robot Intelligence and Task Planning, Modern Robots, Future Application and Challenges and Case Studies.

References

1. Automation, Production Systems and Computer Integrated Manufacturing-M.P. Groover, Pearson Education.5th edition.
2. Robotics, control vision and intelligence-Fu, Lee and Gonzalez. McGraw Hill.
3. Introduction to Robotics- John J. Craig, Addison Wesley Publishing, 3rd edition.
4. Computer Based Industrial Control- Krishna Kant, EEE-PHI,2nd edition.
5. An Introduction to Automated Process Planning Systems- Tiess Chiu Chang & Richard A. Wysk
6. Performance Modeling of Automated Manufacturing Systems, -Viswanandham, PHI, 1st edition.
7. Robotics for Engineers -YoramKoren, McGraw Hill International, 1st edition.
8. Industrial Robotics-Groover, Weiss, Nagel, McGraw Hill International, 2nd edition.

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.

Advanced Manufacturing Processes

EPE – 522 L T P: 3 1 0

Course objective

This course familiarizes students with the advanced manufacturing processes which includes surface treatment, non-traditional machining, laser beam, plasma arc, electron beam and electron chemical machining. This course also covers the processing of composites and fabrication of microelectronic devices.

Particulars

Unit 1

Surface treatment: Scope, Cleaners, Methods of cleaning, Surface coating types, and ceramic and organic methods of coating, economics of coating. Electro forming, Chemical vapour deposition, thermal spraying, Ion implantation, diffusion coating, Diamond coating and cladding.

Unit 2

Non-Traditional Machining: Introduction, need, AJM, Parametric Analysis, Process capabilities, USM – Mechanics of cutting, models, Parametric Analysis, WJM –principle, equipment, process characteristics, performance, EDM – principles, equipment, generators, analysis of R-C circuits, MRR, Surface finish, WEDM.

Unit 3

Laser Beam Machining: Principle of working, equipment, Material removal rate, Process parameters, performance characterization, Applications.

Plasma Arc Machining: Principle of working, equipment, Material removal rate, Process parameters, performance characterization, Applications.

Electron Beam Machining: Principle of working, equipment, Material removal rate, Process parameters, performance characterization, Applications.

Electro Chemical Machining: Principle of working, equipment, Material removal rate, Process parameters, performance characterization, Applications.

Unit 4

Processing of ceramics: Applications, characteristics, classification. Processing of particulate ceramics, Powder preparations, consolidation, Drying, sintering, Hot compaction, Area of application, finishing of ceramics.

Processing of Composites: Composite Layers, Particulate and fiber reinforced composites, Elastomers, Reinforced plastics, MMC, CMC, Polymer matrix composites.

Unit 5

Fabrication of Microelectronic devices: Crystal growth and wafer preparation, Film Deposition oxidation,

lithography, bonding and packaging, reliability and yield, Printed Circuit boards, computer aided design in microelectronics, surface mount technology, Integrated circuit economics. E-Manufacturing, nanotechnology, and micromachining, High speed Machining.

References

1. Manufacturing Engineering and Technology, Kalpakijian, Adisson Wesley, 1995.
2. Process and Materials of Manufacturing, R. A. Lindburg, 4th edition, PHI 1990.
3. Foundation of MEMS/ Chang Liu/Pearson, 2012.
4. Advanced Machining Processes, V.K. Jain, Allied Publications.
5. Introduction to Manufacturing Processes, John A Schey, Mc Graw Hill.

Course outcomes

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

CO1: Understand the methodology of surface treatment

CO2: Understand the working principle of non-traditional machining

CO3: Understand the working of Electron beam, laser beam and laser hybrid welding processes.

CO4: Understand different types of composite material characteristics, types of micro & macro machining processes

CO5: Understand the e-manufacturing & nano materials.

Finite Element Methods

EPE – 523 L T P: 3 1 0

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.

Virtual Work and Variational Principle, Galerkin Method, Finite Element Method: Displacement Approach, Stiffness Matrix and Boundary Conditions.

Unit 2: Element Properties

Natural Coordinates, Triangular Elements, Rectangular Elements, Lagrange and Serendipity Elements, Solid Elements, Isoparametric Formulation, Stiffness Matrix of Isoparametric Elements, Numerical Integration: One Dimensional, Numerical Integration: Two and Three Dimensional, Worked out Examples.

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

Constant Strain Triangle, Linear Strain Triangle, Rectangular Elements, Numerical Evaluation of Element Stiffness Computation of Stresses, Geometric Nonlinearity and Static Condensation, Axisymmetric Element, Finite Element Formulation of Axisymmetric Element, Finite Element Formulation for 3 Dimensional Elements Worked out Examples.

Unit 5: Additional Applications of FEM

Finite Elements for Elastic Stability, Finite Elements in Fluid Mechanics, Dynamic Analysis.

References

1. Introduction to Finite Elements in Engineering by T. R. Chandrupatla and A. D. Belegundu, Pearson Eduction.
2. Finite Element Methods: Basic concepts and applications by Chennakesava R. Alavala, PHI publications.
3. A First Course in Finite Element Method by Daryl L. Logan, Cengage Publication.

4. Finite Element Analysis by C.S. Krishnamurthy Tata McGraw Hill
5. Concepts and Application of Finite Element Analysis by R.D. Cook, D.S. Malcus and M.E. Plesha John Wiley
6. The Finite Element Method by O.C. Zienkiewicz and R.L. Taylor, McGraw Hill
7. Finite Element and Approximation by O.C. Zenkiewicy & Morgan
8. An Introduction to Finite Element Method by J. N. Reddy, McGraw Hill
9. Finite Element Procedure in Engineering Analysis by K.J. Bathe, McGraw Hill

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.

Industrial Design and Ergonomics

EPE – 524 L T P: 3 1 0

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 control situations; design of major controls in automobiles, machine tools etc.; Design of furniture; Redesign of instruments.

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 Hiffee Books Ltd.
2. Introduction to Ergonomics R.C. Bridger McGraw Hill.
3. Human Factor Engineering Sanders & Mc Comlick.

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.

Supply Chain Management

EPE – 525 L T P: 3 1 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

1. Hopp W. J., Spearman M. L. and Irwin, "Factory Physics: Foundations of Manufacturing", McGraw-Hill Inc. New York.
2. Sridhar Tayur, Ram Ganeshan and Michael Magazine (editors), "Quantitative Models for Supply Chain Management", Kluwer Academic Publishers, UK.
3. Handfield R.B. and Nochols E.L.Jr., "Introduction to Supply Chain Management", Prentice Hall Inc. Englewood- Cliff, New Jersey.
4. Viswanadham N. and Narahari Y., "Performance Modeling of Automated Manufacturing Systems", Prentice Hall of India, New Delhi.

5. Viswanadham N., “Analysis of Manufacturing Enterprises”, Kluwer Academic Publishers, UK.
6. Chopra S. and Meindel P., “Supply Chain Management: Strategy, Planning, and Operation”, Prentice Hall of India, New Delhi

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.

Material Characterization

EPE – 526 L T P: 3 1 0

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:

X-ray Diffractometry: Introduction, crystal geometry, lattice directions and planes, zone axis, interplaner spacing and angle, Stereographic projection, Bragg's condition of diffraction, X-ray scattering, application of X-ray diffraction – phase identification, estimation of grain size, particle size, residual stress.

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

1. Goodhew, P.J., Humphreys J. and Beanland, R., "Electron Microscopy and Analysis", Taylor and Francis.

2. Gifkins, R.C., “Optical Microscopy of Metals”, Sir Isaac Pitman and Sons.
3. Cullity, B.D., “Elements of X-Ray Diffraction”, Addison–Wesley Publishing Company.
4. Brown, M.E., “Introduction to Thermal Analysis: Techniques and Applications”, Springer.
5. Speyer, R., “Thermal Analysis of Materials”, 1st ed., CRC Press.

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.

Automated Material Handling System

EPE – 527 L T P: 3 1 0

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

1. Allegri, T. H., "Material Handling Principles and Practice", Krieger Publishing Company.
2. Meyers, F. E. and Stephens, M. P. "Manufacturing Facilities Design and Material Handling", Prentice Hall.
3. Adam, N. D., Brown, T. W., Rowland, V. D. and Misenheimer, F.P., "Warehouse & Distribution Automation Handbook", McGraw-Hill.
4. Sule, D. R., "Manufacturing Facilities-Location, Planning, and Design", 3rd Ed., CRC Press

Course Outcomes

CO1: Ability to understand the material handling.

CO2: Ability to understand different types handling devices.

CO3: Knowledge of basic principal of material handling layout.

CO4: Capability to analyses economic aspect of material handling.

CO5: Ability to understand the material storage.

Metrology and Inspection

EPE – 528 L T P: 3 1 0

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:

Standards in metrology-definition, Traceability, Characteristics Length & Angular measurements Review of standard instruments, GD and tolerance procedure-Review of dimension & form tolerance and methods of measurement, Tolerance analysis.

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:

Light interference - Method of coincidence - Measurement errors. Various tolerances and their specifications,

gauging assembly, comparators. Angular measurements - principles and measuring instruments.

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, Normalisation, 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-Bar code systems, Principles and applications of Colour sensors, electro-magnetic identifier, Tactile sensors, Ultrasonic sensors, Odour sensors.

References

1. Fundamentals of dimensional Metrology T. Busch and R. Harlow Delmar, 3e.
2. Engineering Metrology G. Thomas and G. Butter Worth PUB.
3. Sensors and Control systems in Manufacturing Sabne Soloman McGraw Hill Book.
4. Measurement systems: Applications & Design Doebelin International Student Edition.
5. Optoelectronics for Technology and Engineering Robert G. Seippel Prentice Hall India.
6. Interface Technology for Computer Controlled Ulrich-Rembold, Armbruster Marcel Dekker.
7. Publications, Manufacturing processes and Ulzmann NY.
8. Study manual on tolerance stacks, vol.1 Second edition ASME. 1994.
9. Dimensioning and tolerancing of mass Spotts Prentice Hall, 1983.

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.

Metal Casting

EPE – 529 L T P: 3 1 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, Flaskless moulding, 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, Compactability; 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

1. Bronze Sculpture Casting and Patination: Mud Fire Metal by Steve Hurst Schiffer, Publishing.
2. Fine Art Metal Casting by Richard Rome.
3. Casting Technology and Cast Alloys by Chakraborty, Prentice Hall of India.
4. Meta Casting: Principles and Practice by TV Rammana Rao, New Age International.

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.

2nd Year Scheme and Syllabus

COURSES AND EVALUATION SCHEME
YEAR II, SEMESTER III
(M. Tech. Production Engineering)
(Effective from session: 2019-20)

S. No.	COURSE CODE	SUBJECT	PERIODS			EVALUATION SCHEME					
						SESSIONAL EXAM			ESE	Subject Total	Credits
			L	T	P	CT	TA	Total			
THEORY											
1.	EPE-63X	Elective-V	3	1	0	40	40	80	120	200	4
2.	TOE-63X	Open Elective	3	1	0	40	40	80	120	200	4
PRACTICAL											
3.	PPE-631	Dissertation Phase – I	0	0	16	100	100	200	200	400	8
4.	GPP-631	General Proficiency*	0	0	0	0	50	50	0	50	0
SEMESTER TOTAL			**6**	**2**	**16**	**180**	**180**	**360**	**440**	**800**	**16**

List of Electives

Elective V:

1. EPE-630 Advanced Forming Processes
2. EPE-631 Operation Planning and Control
3. EPE-632 Total Quality Management
4. EPE-633 Quality and Reliability Engineering
5. EPE-634 Financial Management
6. EPE-635 Micro and Nano Manufacturing

List of Open Electives

1. TOE-630 Business Analytics
2. TOE-631 Industrial Safety
3. TOE-632 Operations Research
4. TOE-633 Cost Management of Engineering Projects
5. TOE-634 Composite Materials
6. TOE-635 Waste to Energy

Advanced Forming Process

EPE – 630 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

Mechanics of Forming Processes: Forging-Forces in strip forging and disc forging, Drawing-determination of force and power, Maximum allowable reduction, Deep drawing force analysis, Analysis of tube drawing process with fixed and moving mandrel, Tandem tube drawing, Bending- Determination of work load and spring back, Extrusion-Determination of work load from stress analysis and energy consideration, Power loss.

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
3. Mathematical Simulation and Computer analysis of Thin Strip Rolling Mill by Polukhin, MIR Publications
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.

Operation Planning and Control

EPE – 631 L T P: 3 1 0

Course objective

The course provides an overview of operations & production management.

Particulars

Unit 1: Introduction: An overview of Operations Management

Operations Management: Introduction and overview, Operations Management Strategy framework, Understanding similarities and difference among products, goods and services, Historical evolution of operations management-Changes & Challenges.

Unit 2: Product development: Operations strategy

Product Strategy and integrated product development, Process Strategy, Capacity Planning Decisions, Facilities Location Strategies.

Unit 3: System Design

Facilities Layout and Material Handling Strategy, Group Technology, Flexible manufacturing system, Assembly line balancing, Project Management-CPM/PERT, Line of Balance (LOB).

Unit 4: Productivity & Quality tools

Productivity Concepts: Quality Circle, Kaizen and other SGA, Value analysis and Value Engineering, Total Quality management, Statistical Quality Control, Maintenance Planning and Control (Reliability, availability, maintainability). Work Study-Method study &Work Measurement, Learning Curves, Work Sampling.

Unit 5: Planning and managing operations

Service Operations Management, Lean systems, Constraint management – TOC, Computer integrated manufacturing, Analytical tools for DSS for operations management.

References

1. Aggarwal L.N, Parag Diwan (1997), Management of Production Systems, Global Business Press.
2. Alan Muhlemann, John Oakland, Keith Lockyer (1978), Production and Operations Management, Mac Milan , India, IV Edition.
3. Artiba and S.E Elmaghaby(1997), The Planning and scheduling of production Systems methodologies and Applications, Chapman & Hall.
4. Aswanthappa K, Sridhar Bhatt K(2005), Production and Operations Management, Himalya Publishing House.
5. Barry Render, Jay Heizer(1997), Principles of Operations Management with tutorials, Prentice Hall,

Inc. II Edition.

6. Buffa S.Elwood, Sarin K Rakesh(1987) Instructor's Manual to Accompany Modern Production/Operation Management, John Wiley & Sons Inc III Edition.
7. Chary SN (2004), Production and Operations Management, Tata Mc Graw Hill III Edition.
8. Chase, Jacobs and Aquilano (2005), Operations Management for Competitive advantages, Tata Mc Graw Hill
9. Chunawalla, Patel (2003), Production and Operation Management Himalya Publishing House.
10. Dinesh Seth, Subhash C Rastogi (2003), Global Dinesh Seth, Subhash C Rastogi (2003), Global Management Solutions Thomson South West Edition.
11. Everett Adam, Ronald J Ebert (2004), Production and Operations Management Prentice Hall, IV Edition.
12. Harold T Amrinal, John A Ritchey and Oliver S Hulley (1983) Manufacturing Organization and Operation Management, Prentice Hall, Inc.

Course outcomes

CO1: Able to understand the overview of operations management.

CO2: Able to understand the operation strategy.

CO3: Able to understand system design.

CO4: Able to understand productivity and quality tools.

CO5: Able to understand planning and managing operations.

Total Quality Management

EPE – 632 L T P: 3 1 0

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 Crating satisfied customers, Understanding the customer needs, Process Vs. Customer, internal customer conflict, quality focus, Customer Satisfaction, role of Marketing and Sales, Buyer – Supplier relationships. Bench Marketing: Evolution of Bench Marketing, meaning of Bench marketing, benefits of bench marketing, the bench marketing process, pitfalls of bench marketing.

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 ISO9000 ANSI/ASQCQ-90. Series Standards, benefits of ISO9000 certification, the third party audit, Documentation ISO9000 and services, the cost of certification implementing the system.

References

1. Joel E. Ross, Susan Perry, “Total Quality Management: Text, Cases, and Readings”, CRC Press, 3rd

Edition, 1999.
2. Besterfield D. H. et al., Total quality Management, 3rd ed., Pearson Education Asia, 2006.
3. Evans J.R. and Lindsay W.M., The management and Control of Quality, 8th ed., first Indian edition, Cengage Learning, 2012.
4. Janakiraman B. and Gopal R.K., Total Quality Management, Prentice Hall India, 2006.
5. Suganthi L. and Samuel A., Total Quality Management, Prentice Hall India, 2006.
6. Evans J.R. and Lindsay W.M., The management and Control of Quality, 8th ed., first Indian edition, Cengage Learning, 2012.
7. Zeiri, "Total Quality Management for Engineers", Wood Head Publishers, 1991.
8. Poornima M Charantimath, "Total Quality Management", Pearson Education, 2nd Edition, 2011.

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.

Quality and Reliability Engineering

EPE – 633 L T P: 3 1 0

Course objective

To introduce the concept of SQC and understand process control. Acceptance sampling procedure, their application and learn the concept of reliability.

Unit 1: Introduction and process control for variables:

Introduction, definition of quality, basic concept of quality, definition of SQC, benefits and limitation of SQC, quality assurance, quality control: quality cost-variation in process causes of variation. theory of control chart-uses of control chart, control chart for variables X chart, R chart and σ chart, process capability studies and simple problems, six sigma concepts.

Unit 2: Process control for attributes:

Control chart for attributes, control chart for non-conforming, p chart and np chart. control chart for nonconformities C and U charts, state of control and process out of control identification in charts, pattern study.

Unit 3: Acceptance sampling:

Lot by lot sampling, probability of acceptance in single, double, multiple sampling techniques. O.C. curves – producers' risk and consumers risk. AQL, LTPD, AOQL concepts-standard sampling plans for AQL AND LTPD uses of standard sampling plans.

Unit 4: Reliability:

life testing objective of failure data analysis, mean failure rate, mean time to failure, mean time between failure, hazard rate, weibull model, system reliability, series, parallel and mixed configuration, simple problems. maintainability and availability. acceptance sampling based on reliability test of O.C curves.

Unit 5: Quality and reliability:

Reliability improvements techniques- use of pareto analysis, design for reliability, redundancy unit and standby redundancy. optimization in reliability, product design, product analysis product development and product life cycles.

References

1. John. S. Oakland. “Statistical Process Control”, 5th Edition, Elsevier, 2005.
2. Connor, P.D.T.O., “Practical Reliability Engineering”, John Wiley, 1993.
3. Grant, Eugene. L “Statistical Quality Control”, McGraw-Hill, 1996.
4. Monohar Mahajan, “Statistical Quality Control”, Dhanpat Rai & Sons, 2001.
5. Gupta. R.C, “Statistical Quality Control”, Khanna Publishers, 1997.
6. Besterfield D.H., “Quality Control”, Prentice Hall, 1993.
7. Sharma S.C., “Inspection Quality Control and Reliability”, Khanna Publishers, 1998.

Course outcomes

At the end of this course, students have

CO1: Ability to understand the control chart.

CO2: Ability to understand process chart.

CO3: Knowledge of basic principal of sampling.

CO4: Ability to understand the reliability.

CO5: Capability to analyses reliability engineering.

Financial Management

EPE – 634 L T P: 3 1 0

Course objective

This course aware students with the aspects of financial management.

Unit 1

Introduction to financial management and valuation of financial assets: corporate finance, goal of financial management, FM decisions, financial statements – working with financial statements, ratio analysis, fund flow analysis, time value of money, stock valuation, bond valuation.

Unit 2

Principles of Valuation: Opportunity Cost of Capital; Money-Time relationships and applications; Present Value; Discount Rates; Comparables

Project and Firm Valuation: Evaluating Projects; Net Present Value; Measuring Cash flows, Internal Rate of Return; Firm Valuation; Growth and Free Cash flows; Valuation Models, Accounting vs. Economic Returns.

Unit 3

Cost of capital and long-term financial policy: Raising capital, cost of capital, financial and operating leverage, capital structure theories, dividends and dividend policy, introduction to CAPM.

Unit 4

Risk and Return: Introduction to Risk and Return; Historical Evidence; Measuring the Risk of a Portfolio; Statistics Review; Portfolio Theory; Risk in a Portfolio Context, Trade-off between Risk and Return; Measuring the Risk of a Stock; Discount Rates in Practice.

Unit 5

Special topics: Short-term financial planning – working capital – planning and management. Leasing – meaning – evaluation as an alternative source of financing.

International corporate finance: foreign exchange, exchange rate, interest rate parity – international financing, futures and options in corporate finance.

References

1. Van Horne, “Financial Management and policy”, 12/e, PHI, (2002).
2. Breally and Myers, “Principles of corporate Finance”, 7/e, TMH, (2002).
3. Ross, Westerfield and Jordan, “Fundamentals of corporate Finance”, 6/e, TMH, (2002).
4. Damodaran, “Corporate Finance”, John Wiley & Sons, (2002).

Course outcomes

At the end of this course, students are able to

CO1: Understand the aspect of financial management.

CO2: Understand the principle of valuation.

CO3: Understand the capital cost and policy for long term financial investment.

CO4: Understand the evaluation of risk in investment.

CO5: Understand the features of foreign exchange and investment.

Micro and Nano Manufacturing

EPE – 635 L T P: 3 1 0

Course objective

The objective of this course is to give awareness of different techniques used in micro and nano manufacturing and to introduce other processing routes. Moreover, different techniques used in micro joining and the metrology tools in micro and nano manufacturing also covered in this course.

Particulars

Unit 1: Introduction to Micro and Nano Engineering

Introduction to precision engineering, macro milling and micro drilling, Micro-electromechanical systems-merits and applications, Micro phenomenon in Electro-photography – applications. Introduction to bulk micromachining, Surface micromachining, Micro instrumentation, Micro Mechatronics, Nanofinishing.

Laser Technology in micro manufacturing- Practical Lasers, application of technology fundamentals Introduction to Micro-energy and Chemical system, e-Beam Nano lithography. Introduction to Nanotechnology. Carbon Nanotubes – properties and structures, Nano level Biosensors.

Unit 2: Conventional Micro Manufacturing Techniques

Introduction to mechanical micromachining, Micro drilling, Micro turning, Diamond Micro turning, Micro milling and Micro grinding. Micro Extrusion – process and applications, Micro bending with Laser, Nano plastic forming and Roller imprinting.

Unit 3: Unconventional Micro Nano Manufacturing Techniques

Introduction to unconventional micro nano manufacturing. Abrasive Jet and Water Jet Micro machining-Process, principle and applications. Micro EDM, Micro wire EDM, Micro EBM - Process, principle and applications. Micro ECM, Micro LBM - Process, principle and applications. Focused ion beams - Process, principle and applications.

Unit 4: Micro and Nano Finishing Processes

Introduction to Micro and Nano Finishing Processes Magneto Rheological Finishing (MRF) processes, Magneto Rheological Abrsive Flow Finishing processes (MRAFF) - Process, principle and applications. Elastic Emission Machining (EEM) – machine description, applications. Ion Beam Machining (IBM) – principle, mechanism of material removal, applications. Chemical Mechanical Polishing (CMP) – schematic diagram, principle and applications.

Unit 5: Micro Joining and Metrology Tools

Laser Micro welding, Electron Beam Micro welding – description and applications. Introduction to micro and

nano measurement, defining the scale, uncertainty. Scanning white light Interferometry, – principle and application. Optical Microscopy, Scanning Probe Microscopy – description and application. Introduction to on machine metrology.

References

1. Mark J. Jackson, Micro and Nano-manufacturing, Spinger,2006.
2. Mark J. Jackson, Micro fabrication and Nano- manufacturing – Pulsed water drop micromachining CRC Press 2006.
3. V.K. Jain, Micro – manufacturing Processes, CRC Press, 2012.
4. Micro Machining Methods By J.A. Mc Geough, Champan and Hall, London.
5. Nitaigour Premchand Mahalik, Micro-manufacturing and Nano technology, 2006.

Course outcomes

CO1: Get an awareness of different techniques used in micro and nano manufacturing.

CO2: get in-depth idea of the conventional techniques used in micro manufacturing.

CO3: Become aware about non-conventional micro-nano manufacturing and finishing approaches.

CO4: Get awareness on micro and nano finishing processes.

CO5: Know about different techniques used in micro joining and the metrology tools in micro and nano manufacturing.

Industrial Safety

TOE – 631 L T P: 3 1 0

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

Wear and Corrosion and their prevention: 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 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 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 5

Periodic and preventive maintenance: 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.

References

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

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: Analyze 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.

Operations Research

TOE – 632 L T P: 3 1 0

Course objective

The course provides an overview of operation research.

Particulars

Unit 1

Introduction: Linear programming, Definition, scope of Operations Research (OR) approach and limitations of OR Models, Characteristics and phases of OR Mathematical formulation of L.P. Problems. Graphical solution methods.

Linear Programming Problems: The simplex method - slack, surplus and artificial variables. Concept of duality, Big-M method, Two-phase method, degeneracy, and procedure for resolving degenerate cases.

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

1. Hiller & Lieberman, Introduction to Operations Research
2. Hira D. S. &Gupt P. K., Operations Research, S. Chand & Co. 1995.
3. Taha H. A., Operation Research, 7th Ed., Prentice Hall of India, New Delhi, 2002.

4. Wagner H. M., Principles of Operation Research with Applications to Managerial Decisions, 2nd Ed., PHI, 2010.
5. Vohra N.D, Quantitative Techniques in Management, Tata McGraw Hill, 1995.
6. Sharma J. K., Operation Research Theory and Applications, 2nd Ed., Macmillan, 2003.
7. Kasana H. S., Kumar K. D., Introductory Operations Research Theory and Applications, Springer, 2003.
8. Wilkes F. M., Elements of Operational Research, McGraw Hill Co.
9. Levin R. et.al, Quantitative approaches to Mgmt, McGraw Hill Co.
10. Richard Broson, Govindasamy & Naachimuthu, Schaum's Outline of Theory and Problems of Operations Research, II Edition, Tata McGraw Hill , 2004.
11. En R. P., Operations Research Algorithm and Applications, PHI, New Delhi.
12. Shah N. H., Gor R. M., Soni H., Operations Research, PHI, New Delhi, 2007.

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.

Composite Materials

TOE – 634 L T P: 3 1 0

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

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 2: Reinforcements

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 3: Manufacturing of Metal Matrix Composites

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 4: Manufacturing of Polymer Matrix Composites

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

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

1. K.K. Chawla, Composite Materials – Science & Engineering, Springer-Verlag, New York, 1987.
2. F.L. Matthews and R.D. Rawlings, Composite Materials: Engineering and Science, Chapman & Hall, London, 1994.
3. Dr Navin 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.

Waste to Energy

TOE – 635 L T P: 3 1 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: Cl and Sl 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

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

2. D.O Hall and R.P. Overeed, Biomass – regenerable energy, John Willy and Sons Ltd. New York. 1987.
3. Fay JA, Golomb DS. Energy and Environment, Oxford University Press (2002).
4. Brown RC and Stevens C, Thermo-chemical Processing of Biomass: Conversion into Fuels, Chemicals and Power, Wiley and Sons (2011).

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.

COURSES AND EVALUATION SCHEME
YEAR II, SEMESTER IV
(M. Tech. Production Engineering)
(Effective from session: 2019-20)

S. No.	COURSE CODE	SUBJECT	PERIODS			EVALUATION SCHEME					
						SESSIONAL EXAM			ESE	Subject Total	Credits
			L	T	P	CT	TA	Total			
PRACTICAL											
1.	PPE-641	Dissertation Phase – II	0	0	28	175	175	350	350	700	14
2.	PPE-642	Seminar	0	0	4	50	50	100	0	100	2
3.	GPP-641	General Proficiency	0	0	0	0	50	50	0	50	0
SEMESTER TOTAL			**0**	**0**	**32**	**225**	**225**	**450**	**350**	**800**	**16**