(With effect from the Academic Year 2016-17)

SRI VENKATESWARA UNIVERSITY: TIRUPATI

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING

DEPARTMENT OF MECHANICAL ENGINEERING

Course

M.Tech MECHANICAL ENGINEERING

(Production Engineering)

Choice Based Credit System (CBCS)

Academic Year 2017-2018

VISION:

To be a globally renowned center for quality education and innovative research in Mechanical Engineering

MISSION:

M1	Prepare effective and responsible graduate engineers for global requirements.
M2	Continuously strive to improve pedagogical methods employed in delivering the academic programs.
M3	Respond dynamically to the changing requirements of the industry.
M4	Conduct basic and applied research to contribute to intellectual human capital.
M5	Inculcate the spirit of entrepreneurship and social responsibility.

PROGRAM OUTCOMES

Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and

safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assesssocietal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

SEMESTER – I

Course Code	Course Title	Instructions			Marks		Credits
		Hours / Week			Sess-ionals	End Exam	
		L	T	D/P			
MAME T01	Applied Probability and Statistics *	4	--	--	40	60	4
MEPE T01	Advanced Materials Technology	4	--	--	40	60	4
MEPE T02	Advanced Manufacturing Processes	4	--	--	40	60	4
MEIE T03	Operations Planning and Control *	4	--	--	40	60	4
	Elective – I	4	--	--	40	60	4
	Elective – II	4	--	--	40	60	4
MEPE P01	Production Engineering Laboratory	--	--	3	40	60	2
MEPE S01	Seminar	--	--	3	--	100	2
	Total	24		6	280	520	28

SEMESTER – II

Course Code	Course Title	Instructions			Marks		Credits
		Hours / Week			Sess-ionals	End Exam	
		L	T	D/P			
MEPE T03	Computer Integrated Manufacturing	4	--	--	40	60	4
MEPE T04	Automation in Manufacturing	4	--	--	40	60	4
MEPE T05	Additive Manufacturing	4	--	--	40	60	4
MEPE T06	Metal Cutting and Cutting Tool Design	4	--	--	40	60	4
	Elective – III	4	--	--	40	60	4
	Open Elective	4	--	--	40	60	4
MEPE P02	CAD / CAM Laboratory	--	--	3	40	60	2
MEPE V01	Comprehensive Viva	--	--	3	--	100	2
	Total	24		6	280	520	28

SEMESTER – III & IV

Course Code	Course Title	Instructions			Marks		Credits
		Hours / Week			Sess-ionals	End Exam	
		L	T	D/P			
MEPE J01	Dissertation	--	--	--	40	60	24

Elective – I, II & III should be chosen from the following list of Electives

Course Code	Course Title
MEPE E01	Robotics
MEPE E02	Advanced Casting Technology
MEPE E03	Oil Hydraulics and Pneumatics
MEPE E04	Metrology and Computer Aided Inspection
MEPE E05	Expert Systems in Manufacturing
MEPE E06	Advanced Welding Processes
MEPE E07	Metal forming Technology
MEPE E08	Finite Element Method
MEPE E09	Energy Management *
MEPE E10	Design for Manufacturing *
MEIE E09	Design and Analysis of Experiments *
MEIE E10	Productivity Engineering and Management *

List of Open Electives to be offered for other Departments:

Course Code	Course Title
MEOE T01	Project Management *
MEOE T02	Non Conventional Energy Sources *

* Common to Industrial Engineering and Production Engineering

MAME T01 APPLIED PROBABILITY AND STATISTICS

M.Tech I Semester
Common to Industrial Engineering & Production Engineering

Lectures / Week: 4 periods

Course Objectives:

1. To identify suitable random variables for discrete and continuous probability estimation.
2. To understand the suitability of the mathematical distributions for the industrial applications
3. To study the sampling theory and apply in prediction of the event and analyze the statistical distributions by process of matrices.

Course Content:

UNIT-I

Introduction to probability: Probability, sample space — axioms of probability, Random variables — Discrete and Continuous — Expectations — Moment Generating functions. Conditional probability — Bayer's theorem — Independent Events.

UNIT-II

Discrete distributions: Binomial, Hyper geometric, Gama, Students t, Chisquare, Weibell distributions.

Bivariate random variables and their distributions (with specific reference to bivariate normal distributions only). Conditional distributions — Covariance, Correlation coefficient — Regression of the mean.

UNIT-III

Functions of random variables: Probability distribution of functions of random variables their joint probability distribution.

Sampling: Sampling Distribution — Law of Large Numbers — Central Limit theorem.

UNIT-IV

Estimation: Point Estimation, Interval Estimation and Confidence Intervals. (Maximum Likelihood Estimation), Bayesians Estimation.

Testing of Hypothesis: Simple hypothesis and the Neyman — Pearson lemma — Composite hypothesis — goodness of fit tests.

UNIT-V

Analysis of variance: One way classification — Randomized, complete block designs.

Course Outcomes:

At the end of the course student will be able to learn the-

1. Basic concepts of sampling applied in population enumeration.
2. Regression techniques for application and forecast the demand and related variables
3. Testing of hypothesis using statistical distributions.
4. Correlation between the observed values and experimental values for analysis of variance.

Contribution to outcomes will be achieved through

1. Class room teaching (chalk board, and presentations)
2. Discussions on case studies.
3. Tutorial Classes/Practice Sessions

Assessment of outcomes

1. Two Internal tests each of 20 marks.
2. Assignments.
3. Daily class room interactions.
4. Presentations by students.

REFERENCES

1. Ian F. Blake, An introduction to Applied Probability — John Wiley & Sons (1979)
2. Milton, J.S., Arnold, Jee C., Probability and Statistics in the Engineering and Computing Sciences — Mc Grawhill, 2003.

Mapping of Course Outcomes with Program Outcomes:

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

MEPE T01 **ADVANCED MATERIAL TECHNOLOGY**

M.Tech I Semester
Production Engineering

Lectures / Week: 3 periods

Course Objectives:

1. Able to understand the concept of materials i.e., conventional materials such as metallic and nonmetallic materials with their structures and applications.
2. Able to know the need for newer materials by comparing the limitations of conventional materials along with their properties and applications.
3. Able to compile about the properties, structure of ceramic materials and their need for newer applications and processing techniques.

Course Content:

UNIT-I

Introduction to composite materials

Definition, Classification, Types of matrices & reinforcements, characteristics & selection, Fiber composites, laminated composites, particulate composites, prepregs, sandwich construction.

UNIT-II

Micro mechanical analysis of a lamina

Introduction, Evaluation of the four elastic moduli – Rule of mixture, ultimate strengths of unidirectional lamina.

UNIT-III

Macro mechanics of a lamina:

Hooke's law for different types of materials, number of elastic constants, Two – dimensional relationship of compliance & stiffness matrix. Hooke's law for two dimensional angle lamina, engineering constants – angle lamina, Invariants, Theories of failure.

UNIT-IV

Macro Mechanical analysis of laminate:

Introduction, code, Kirchoff hypothesis – CLT, A, B, & D matrices, Engineering constants, Special cases of laminates, Failure criterion.

UNIT-V

Nuclear Materials

Introduction to nuclear materials. Materials for nuclear fuel in fission and fusion reactors, Fissile and fertile materials. Control & Construction Materials for Nuclear reactors, Moderators, Heat Exchangers. Radiation proof materials. Brief discussion of safety and radioactive waste disposal.

Course Outcomes:

1. Students are capable to define the concept of materials i.e., conventional materials with their structure, such as electronic configuration, structure of atom, etc.
2. Students become aware of different conventional materials such as metallic and nonmetallic materials, structures and their applications.
3. Students will be able to demonstrate the need for newer materials by comparing the limitations of conventional materials.
4. They will be able to compare the types of newer materials along with their properties and applications.

5. They will be able to compile about the properties, structure of ceramic materials and their need for newer applications and processing techniques.

REFERENCES:

1. Composite Materials handbook - Mein Schwartz - Mc Graw Hill Book Company - 1984.
2. Mechanics of composite materials - Autar K. - Kaw CRC Press New York. – 1st edition, 1997.
3. Mechanics of composite materials - Rober M. Joness - McGraw Hill Kogakusha Ltd. – 2008.
4. Introduction to Nuclear Engineering, by J.R Lamarsh.
5. W.D. Callister, Jr, - Material Science & Engineering Addition-Wesly Publishing Co.

Mapping of Course Outcomes with Program Outcomes:

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

ADVANCED MANUFACTURING PROCESSES

M.Tech I Semester
Production Engineering

Lectures / Week: 3 periods

Course Objectives:

1. To learn about various unconventional machining processes, the various process parameters and their influence on performance and their applications
2. Understand various surface processing operations.
3. Able to learn about the fiber reinforced composites, Elastomers, Reinforced plastics, MMC, CMC, Polymer matrix composites.

Course Content:

UNIT-I

Abrasive jet machining: Elements of the process, mechanics of metal removal process parameters, economic considerations, applications and limitations, recent developments.

Ultrasonic machining: Elements of the process, machining parameters, effect of parameters on surface finish and metal removal rate, mechanics of metal removal process parameters, economic considerations, applications and limitations.

UNIT-II

Electro-Chemical Processes: Fundamentals of electro chemical machining, metal removal rate in ECM, Tool design, Surface finish and accuracy economics aspects of ECM.

Wire EDM Process: General Principle and applications of Wire EDM, Mechanics of metal removal, Process parameters, and selection of tool electrode and dielectric fluids, methods surface finish and machining accuracy.

UNIT-III

Electron Beam Machining: Generation and control of electron beam for machining, theory of electron beam machining, principle, advantages, and limitations, comparison of thermal and non-thermal processes.

Plasma Arc Machining: Principle, machining parameters, effect of machining parameters on surface finish and metal removal rate, applications, limitations

UNIT-IV

Laser Beam Machining: Principle, effect of machining parameters on surface finish, applications, and limitations.

Surface Processing Operations: Plating and Related Processes, Conversion Coatings, Physical Vapor Deposition, Chemical Vapor Deposition, Organic Coatings, Porcelain Enameling and other Ceramic coatings, Thermal and Mechanical Coating Processes.

UNIT-V

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.

Course Outcomes:

1. Students can able to demonstrate different unconventional machining processes
2. Able to test the influence of different process parameters on the performance and their applications
3. Able to select the different types of composites for different applications.

REFERENCES:

1. Fundamentals of Modern Manufacturing- Mikell P. Groover, John Wiley & Sons Publishers
2. Modern Machining Process - P.C Pandey and H.S Shan, Tata McGraw - Hill Education (1980)
3. Manufacturing Engineering and technology – Serope Kalpakjian & Stephen Schmid
4. Advanced Machining Processes / V.K.Jain / Allied Publications.
5. Introduction to Manufacturing Processes / John A Schey / Mc Graw Hill.
6. Process and Materials of Manufacturing / R. A. Lindburg / 1th edition, PHI 1990.

Mapping of Course Outcomes with Program Outcomes:

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

MEIE T03 OPERATIONS PLANNING AND CONTROL

M.Tech I Semester

Common to Industrial Engineering & Production Engineering

Lectures / Week: 4 periods

Course Objectives:

1. To understanding the production processes involved in the manufacturing of a product
2. To forecast the production demand and estimate and plan the schedule activities.
3. To plan the loading of work stations and scheduling for line balancing and LOB.

Course Content:

UNIT-I

OPC a system approach. Types of production and OPC functions.

Forecasting: Forecasting Methods — Qualitative Methods — Quantitative methods — moving average and exponential smoothing methods for different data patterns. Forecast errors, Tracking signal.

UNIT-II

Mass Production Management Principles of flow lines, Assembly line balancing; approach to line balancing — RPW, COMSOAL, Integer and Dynamic programming formulations. Introduction to transfer lines.

Production Planning Linear programming formulations for static demand case, Product Mix Decisions. Chance constrained programming models.

UNIT-III

Aggregate Production Planning Production planning under dynamic conditions strategies, costs involved; Heuristic methods, linear production and inventory programmes. Aggregate production planning — HMMS model, search decision, parametric production planning, management coefficient models. Disaggregation — hierarchical planning, mathematical programming formulations. Master Production Schedule.

UNIT-IV

Operations Scheduling Flow shop sequencing and job scheduling.

Periodic review models. Continuous review models, lot size models with dynamic demand, inventory models of spare parts.

UNIT-V

Materials Requirement Planning (MRP) Introduction. Inventory in a manufacturing environment. Principles of MRP, MRP processing logic. MRP systems, and MRP — II, Jut-In-Time manufacturing: set-up reduction, stable MPS and Kanban control.

Course Outcomes:

At the end of the course student will be able to learn the-

1. Forecasting principles and techniques for short range and long range planning

2. Production requirements for each product and plan the shop floor activities
3. Work station loading and scheduling of paths to avoid bottle necks for smooth production
4. Solution for product mix decision using OR techniques.
5. Optimal job sequences to achieve the minimum make span with maximum production output

Contribution to outcomes will be achieved through

1. Class room teaching (chalk board, and presentations)
2. Discussions on case studies.
3. Tutorial Classes/Practice Sessions

Assessment of outcomes

1. Two Internal tests each of 20 marks.
2. Assignments.
3. Daily class room interactions.
4. Presentations by students.

REFERENCES

1. Montgomery, Operations Research in Production Planning, Scheduling and Inventory Control — Prentice Hall, N.J
2. Buffa, E.S., Operations Management — John Wiley & Sons.
3. Elsyod and Boucher Analysis of Production Systems, Prentice Hall, N.J,ISE Series
4. Burbridge, Production Planning — Heinemann Publishers, 1971.

Mapping of Course Outcomes with Program Outcomes:

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

PECP02 PRODUCTION ENGINEERING LAB –I

List of Experiments:

1. Inspection of drill JIG.
2. Simulation of CNC programming, using XL turning m/c
3. Simulation of CNC programming, using milling m/c
4. Screw thread measurement using profile projector
5. Straightness testing by using Wedge method.
6. Study of measuring Instruments
7. Sine bar
8. Sand analysis

MEPE T03 COMPUTER INTEGRATED MANUFACTURING

M.Tech II Semester
Production Engineering

Lectures / Week: 4 periods

Course Objectives:

1. To impart knowledge of automated processes in a modern manufacturing environment.
2. To give broad understanding of using engineering design and modeling techniques towards flow lines, numerical control and the integration of computer control/usage in manufacturing.
3. To learn contemporary manufacturing/production strategies such as agile manufacturing and group technology.

Course Content:

UNIT-I

Introduction: Scope of computer integrated manufacturing, Product cycle, Production automation.

Group technology: Role of group technology in CAD/CAM integration, Methods for developing part families, Classification and coding, Examples of coding systems, Facility design using group technology, Benefits of G.T.

UNIT-II

Computer aided process planning: Role of Process Planning, Approaches to process planning- Manual, Variant, Generative approach; Examples of Process planning systems - CAPP, DCLASS, CMPP; Criteria for selecting a CAPP system, Benefits of CAPP.

UNIT-III

Integrative manufacturing planning and control: Role of integrative manufacturing in CAD/CAM integration, Over view of production control - Forecasting, Master production schedule, Rough – Cut Capacity planning, M.R.P., Capacity Planning, Order release, Shop-floor control, Quality assurance, Manufacturing Planning and control systems; Cellular manufacturing, JIT manufacturing.

UNIT-IV

Computer aided quality control: Terminology in quality control, Contact inspection methods, Non-contact inspection methods, Computer aided testing, Integration of CAQC with CAD/CAM.

UNIT-V

Computer integrated manufacturing systems: Types of manufacturing systems, Machine tools and related equipment, Material handling systems, Computer control systems, CIMS Benefits.

References*:*

1. Computer Integrated Design and Manufacturing by David D. Bedworth, Mark R. Henderson, Philip M. Wolfe.
2. CAD / CAM by Groover & Zimmers (PHI)

3. Automation, Production systems and Computer Integrated Manufacturing- by M.P.Groover (PHI)
4. “Computer Integrated Manufacturing System”, Yorem koren, McGraw-Hill, 1983.
5. “Computer Integrated Manufacturing”, Ranky, Paul G., Prentice Hall International, 1986.

Course Outcomes:

At the end of the course student will be able to learn the-

1. Understand the effect of manufacturing automation strategies and derive production metrics.
2. Analyze automated flow lines and assembly systems, and balance the line.
3. Design automated material handling and storage systems for a typical production system.
4. Design a manufacturing cell and cellular manufacturing system.
5. Develop CAPP systems for rotational and prismatic parts.

Mapping of Course Outcomes with Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2										
CO2			3	3	1							
CO3			4	3								
CO4			4									
CO5			4									

MEPE T04 AUTOMATION IN MANUFACTURING

M.Tech II Semester

Production Engineering

Lectures / Week: 4 periods

Course Objectives:

1. To study the types and strategies and various components in Automated Systems.
2. To understand the automated flow lines, line balancing, material storage and retrieval and inspection
3. To learn the adaptive control systems.

Course Content:

UNIT-I

Introduction: Types and strategies of automation, pneumatic and hydraulic components, circuits, automation in machine tools, mechanical feeding and tool changing and machine tool control.

UNIT-II

Automated Flow Lines: Methods of part transport, transfer mechanism, buffer storage, control function, design and fabrication considerations.
Analysis of automated flow lines - General terminology and analysis of transfer lines without and with buffer storage, partial automation, implementation of automated flow lines.

UNIT-III

Assembly System And Line Balancing: Assembly process and systems, assembly line, line balancing methods, ways of improving line balance, flexible assembly lines.

Automated Material Handling And Storage Systems: Types of equipment, functions, analysis and design of material handling systems, conveyor systems, automated guided vehicle systems. Automated storage and retrieval systems; work in process storage, interfacing handling and storage with manufacturing.

UNIT-IV

Adaptive Control Systems: Introduction, adaptive control with optimization, adaptive control with constraints, application of adaptive control in machining operations. Consideration of various parameters such as cutting force, temperatures, vibration and acoustic emission in the adaptive controls systems.

UNIT-V

Automated Inspection: Fundamentals, types of inspection methods and equipment, Coordinate Measuring Machines, Machine Visio.

REFERENCES:

1. Automation, Production Systems and Computer Integrated Manufacturing/ M.P. Groover./ Prentice Hall
2. Computer Control of Manufacturing Systems / Yoram Coren/Tata McGraw-Hill edition
3. CAD / CAM/ CIM /P. Radhakrishnan, S.Subrahmanyam,V.Raju/New Age international Publishers
4. Automation / W. Buekinsham, 3rd Edition/PHI Publications

Course Outcomes:

At the end of the course student will be able to learn the-

1. Solve the line balancing problems in the various flow line systems with and without use buffer storage
2. Understand the different automated material handling, storage and retrieval systems and automated inspection systems.
3. Use of Adaptive Control principles and implement the same online inspection and control

Mapping of Course Outcomes with Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		3										
CO2	2				3							
CO3		2		3								

MEPE T05 ADDITIVE MANUFACTURING

M.Tech II Semester

Production Engineering

Lectures / Week: 4 periods

Course Objectives:

1. To learn the time compression technologies in the product development and manufacturing.
2. Able to model and fabrication of various complex engineering products.
3. Applications of additive manufacturing technologies in product development and manufacturing.

Course Content:

UNIT-I

Introduction: Introduction to Prototyping, Traditional Prototyping Vs Rapid Prototyping (RP), Need for time compression in product development, Usage of RP parts, Generic RP process, Distinction between RP and CNC and other related technologies, Classification of RP, Need for RP software, MIMICS, Magics, SurgiGuide, 3-matic, 3D-Doctor, Simplant, Velocity2, VoXim, SolidView, 3DView, etc., Preparation of CAD models, Problems with STL files, STL file manipulation, RP data formats: SLC, CLI, RPI, LEAF, IGES, HP/GL, CT, STEP.

UNIT-II

Rapid Prototyping (RP) Processes:

Photopolymerization RP Processes: Stereolithography (SL), SL resin curing process, SL scan patterns, Microstereolithography, Applications of Photopolymerization Processes,

Powder Bed Fusion RP Processes: Stereolithography (SL), SL resin curing process, SL scan patterns, Microstereolithography, Applications of Photopolymerization Processes

Extrusion Based RP Processes: Fused Deposition Modelling (FDM), Principles, Plotting and path control, Applications of Extrusion-Based Processes

Printing RP Processes: 3D printing (3DP), Research achievements in printing deposition, Technical challenges in printing, Printing process modelling, Applications of Printing Processes

Sheet Lamination RP Processes: Laminated Object Manufacturing (LOM), Ultrasonic Consolidation (UC), Gluing, Thermal bonding, LOM and UC applications

Beam Deposition RP Processes: Laser Engineered Net Shaping (LENS), Direct Metal Deposition (DMD), Processing-structure-properties, relationships, Benefits and drawbacks

UNIT-III

Rapid tooling: Conventional Tooling Vs. Rapid Tooling, Classification of Rapid Tooling, Direct and Indirect Tooling Methods, Soft and Hard Tooling methods

UNIT-IV

Reverse engineering: Reverse Engineering (RE) Methodologies and Techniques, Selection of RE systems, RE software, RE hardware, RE in product development

UNIT-V

Errors in RP processes and applications: Pre-processing, processing, post-processing errors, Part building errors in SLA, SLS, etc., Design, Engineering Analysis and planning applications, Rapid Tooling, Reverse Engineering, Medical Applications of RP

REFERENCES:

1. Chua Chee Kai., Leong Kah Fai., Chu Sing Lim, Rapid Prototyping: Principles and Applications in Manufacturing, World Scientific, 2010.
2. Ian Gibson., David W Rosen., Brent Stucker, Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Springer, 2010.
3. Rafiq Noorani, Rapid Prototyping: Principles and Applications in Manufacturing, John Wiley & Sons, 2006.
4. D. T. Pham, S. S. Dimov, Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, Springer, 2011,

Course Outcomes:

At the end of the course student will be able to learn the-

1. Identify the need for time compression in product development and manufacturing.
2. Model and fabricate any complex engineering product.
3. Select the rapid manufacturing technology for a given application.
4. Minimize various errors that are occurring during conversion of CAD models.
5. Illustrate the working principles of various rapid manufacturing technologies.

Optimize the quality of parts produced by the various rapid manufacturing technologies

Mapping of Course Outcomes with Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	4									
CO2				3								
CO3			2									
CO4				4	2							
CO5	2				3							

MEPE T06 METAL CUTTING AND CUTTING TOOL DESIGN

M.Tech II Semester
Production Engineering

Lectures / Week: 4 periods

Course Objectives:

1. To learn the modeling technique for machining processes and interpretation of data for process selection
2. To understand the mechanics and thermal issues associated with chip formation
3. To learn the concept of the effects of tool geometry on machining force components and surface finish, machining surface finish and material removal rate

Course Content:

UNIT-I

Cutting tool geometry – Tool terminology – Tool signature/nomenclature of single point cutting tool – Tool geometry in ASA, ORS and NRS systems – Functional angles – true rake and inclination angle – Deformation of metals during cutting – Basic mechanics of metal cutting process – Mechanism of chip formation – Orthogonal cutting and Oblique cutting – Thin zone model and thick zone model – Types of chip – Chip curl – Chip breakers.

UNIT-II

Thin zone model – Merchant analysis – Kinematics of chip –Calculation of metal cutting strain – Measurement of Cutting forces – Dynamometry – Merchant theory and Lee and Shaffer theory – Friction in metal cutting – Effect of friction. Cutting tool materials – Coating of cutting tools – chemical vapour deposition and physical vapour deposition methods.

UNIT-III

Thermal aspects of machining and cutting temperatures and Acoustic Emission (AE) in metal cutting. Cutting fluids – Basic forms of wear in metal cutting – Adhesive, Abrasive and solid – state diffusion. Tool wear and Tool failure – crater wear and flank wear – wear land – Tool life equation – Variables affecting tool life. Economics of machining.

UNIT-IV

Fundamentals of drilling and grinding – Power of drilling – Theory of grinding – Cutting tool design – Types – single point and multi – point cutting tools – Design of a single point turning tool – strength and rigidity criteria – Design of multi – point cutting tools – Profile milling cutters, Drills, Broach and design of Form tools.

UNIT-V

Developments in cutting tool materials for high speed machining, Introduction to micromachining, Differences between macro cutting and micro cutting, characteristics of micro cutting – size effect, minimum chip thickness, specific power consumption etc.

REFERENCES:

1. N. Lopenz de Lacalle et al. Machine tools for high performance machining, Springer, 2009

2. Cyril Donaldson, Tool Design, Tata McGraw Hill Edition
3. ASTME Handbook Tool Design,PHI.
4. Tool Design Pollock,Reston D Taraporevala Sons,1983
5. Tool Design Nagpal, Khanna Publishers — 1991
6. G.Kuppuswamy, Principles of Metal Cutting, Orient Longmans, Hyderabad, India
7. B.L Juneja G.S.Sekhon — Fundamentals of Metal Cutting and M.K tools, New Age
8. India Pvt. Ltd. Publihers.

Course Outcomes:

At the end of the course student will be able to learn the-

1. Ability to extend, through modeling techniques, the single point, multiple point and abrasive machining processes
2. Estimate the material removal rate and cutting force, in an industrially useful manner, for practical machining processes
3. Prediction of the surface finish in machining processes
4. Understand the practical aspects of tool wear and tool life, and their influence on economics
5. Understand the tool and work piece temperatures and their effect on quality

Mapping of Course Outcomes with Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2		3		3							
CO2	2	3										
CO3			3									
CO4	2			3								
CO5		2					2					

MEPE P02 CAD / CAM LABORATORY

M.Tech II Semester
Production Engineering

Lectures / Week: 3 periods

C Programming.

1. Bresenhams Line Algorithm,
2. Transformations matrixes (Scaling, Rotation, Translation, Reflection, mirroring)
3. Bezier Curve fitting
4. Drawing in Auto CAD 2D and 3D Models
5. Simple treatment only
6. Edge CAM, Iron CAD, Robo cell software, CATIA.

Course Outcomes:

At the end of the course student will be able to learn the-

1. Practicing the concepts of computer programming for line, circle and other curve generation
2. Knowing the programme for transformation of mathematical matrices for translation, rotation, scaling and mirror reflection
3. Knowing and writing the programs to develop bezier and other curve fitting.
4. Knowing the utilization and application of Auto CAD software in 2D and 3D models
5. Training and usage of Edge CAM Iron CAD, Robo cells, CATIA and CAD / CAM softwares

Mapping of Course Outcomes with Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2				3							2
CO2		3		2	4				3			
CO3	2		3									3
CO4	3		3		5							
CO5	2		5	3	4				3			2

MEPE E01 ROBOTICS

Production Engineering
Elective

Lectures / Week: 4 periods

Course Objective:

1. To introduce the basic concepts of robots and automation.
2. To make the student familiar with the various drive systems for robot, sensors and their applications in robots and programming of robots.
3. Able to design end effectors, grippers, sensor, machine vision robot kinematics and programming and able to solve the problems relating to forward and inverse kinematics

Course Content:

UNIT-I

Fundamentals of robotics – Automation and robotics, Robot Anatomy, Four common robot configurations – SCARA robot – kinematic joints – prismatic, revolute, twisting and revolving Robot wrist motions – YPR motions– Robot work volumes – Robot characteristics – Spatial resolution, Accuracy, Repeatability.

UNIT-II

Control Systems and components – Basic control systems components and models – Mathematical models, transfer function – Block diagrams, Characteristic equations – Controllers – Proportional control , Integral control, Proportional and Derivative (PD) control, Proportional and Integral (PI) control and PID Control. Stability and speed of response of a robot arm.

UNIT-III

Drive systems and sensors –Servo controlled and non-servo controlled robots. Powering of the robot arm – Hydraulic, Pneumatic and Electric drives – Robot joint control design. Types of sensors – Contact and non – contact type sensors – Position sensors – velocity sensors – force sensors – torque sensors – Tactile sensor – proximity and range sensors – Vision sensors.

UNIT-IV

Trajectory planning of a robot arm – cubic polynomials – Trajectory planning and robot controller. Robot end – effectors – grippers and tools – Mechanical grippers – types of gripper mechanisms – gripper force analysis – vacuum grippers – magnetic grippers – Remote Centre Compliance (RCC) device.

UNIT-V

Robot arm kinematics – Homogeneous transformation matrix – DH matrix – Forward and Inverse kinematics of 2R and 3R robot manipulators, Robot Programming methods – Off – line programming and On – line programming – Manual programming, Lead through programming, robot programming languages. Industrial applications of robots.

TEXT BOOKS

1. Mikell P. Groover, Mitchell Weiss, Roger N. Nagel and Nicholas G. Odrey, “Industrial Robotics Technology, Programming and Applications”, Mc Graw Hill Book company, 1986
2. R.K. Mittal and I.J. Nagrath, “Robotics and Control”, McGraw Hill Education (India) Private Ltd., 2014.
3. Gonzalez K.S.F.U.R.C. and Lee C.S.G., “Robotics- Control, Sensing, Vision, and Intelligence” Mcgraw-Hill Book Company (July 1987).
4. Deb S.K, Deb.S, “Robotics Technology and Flexible Automation”, Tata McGraw-Hill Education Private Limited, 2009.
5. Ganesh S. Hegde, A text book on Industrial Robotics, Laxmi Publications (P) Ltd., 2007.

REFERENCES

1. John J. Craig, Introduction to Robotics Mechanics and Control, Second Edition, Addison Wesly Longman Inc. International Student edition, 1999
2. Mark W. Sponge & Vidya Sagar M., “Robot Dynamics and Control” ,Wiley; 1st Edition (1989)
3. Tsuneo Yohikwa, Foundations of Robotics Analysis and Control, Prentice Hall of India Pvt. Ltd., 2001

Course Outcomes:

At the end of the course student will be able to learn the-

1. Importance of robotics in today and future goods production
2. Robot configuration and subsystems
3. Principles of robot programming and handle with typical robot
4. Working of mobile robots
5. The Student must be able to design automatic manufacturing cells with robotic control using the principle behind robotic drive system, end effect ors, sensor, machine vision robot kinematics and programming

Mapping of Course Outcomes with Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2										2	3
CO2				3								
CO3	3		2			3			1			
CO4	2	3			3							
CO5	3		2			5						2

MEPE E02 ADVANCED CASTING TECHNOLOGY

Production Engineering
Elective

Lectures / Week: 4 periods

Course Objectives:

1. Able to learn the different moulding materials of sands, binders and design of furnaces
2. Able know the basic concepts of casting design, design of running and feeding systems
3. Able to understand the concepts of nonferrous foundry metallurgical properties of liquid metals, foundry mechanization and process flow charts

Course Content:

UNIT-I

Moulding Materials Sand — Silica, Zircon, Chromite, Olivine sands; Binders — Bentonite, cement, sodium silicate, Ethyl silicate, plaster of paris, carbohydrates, setting oils, synthetic regins; Additives — Coal dust, wood flour, silica flour; Mould and core coatings; Moulds auxiliary materials; Parting agents, core paste, exothermic, insulating sleeve materials; Sand testing and controls.

UNIT-II

Furnaces Design features of Arc and Induction furnaces, heat treatment furnaces including salt bath furnaces and induction heating

UNIT-III

Principles of Casting Design Basic concepts of Engg. analysis of metal fabrication with particular reference to casting processes. Factors influencing the production' of engg., castings to customers' specifications, attem making. Chvorinov's rule, design of running and feeding systems; factors influencing the engg. design of castings. Functional design, freezing range alloys in metallic and non — metallic moulds, grain refinement, modification, various types of defects in non — ferrous alloys, influence of form and environment.

UNIT-IV

Nonferrous foundry metallurgy Properties of liquid metals, their significance in foundry practice, oxidation, solution of gases in metals, fluidity, hot tear, shrinkage and solidification Mechanisms of pure metals, Eutectic and long range freezing alloys — some advances in die casting including Acurad process — some features of steel foundry practice, specification of moulding material, Foundry practice of nonferrous metals and alloys.

UNIT-V

Foundry Mechanization and management

General principles and objectives, Plant layout Mechanization foundries, selection of equipment, operation and flow process charts

REFERENCES

1. Rosenthal et al., Principles of MetalCasting — Tata Mc Grawhill Publishers.
2. Ruddle Riser and Gating design
3. Murphi Non — ferrous Foundry Metallurgy
4. Tompkins and White Facilities planning — John wiley & Sons.
5. Filnn Metal Casting — Prentice Hall India.
6. P. L. Jam Principles ofMetal Casting — Tata McGrawhill
7. O. P. Khanna Foundry Technology — Khanna Publishers.

Course Outcomes:

At the end of the course student will be able to learn the-

1. Knowing and identification of materials for moulding the additives, coating and the methods of sand controls
2. Identification of different furnaces for metal melting and design the suitable furnace depending materials
3. Understanding of the concepts related to the casting processes and the factor those influence the design process for metals and alloys
4. Knowing the various properties of liquid metals and their compositions and attain the various alloys depending upon the temperature, Iron-carbon diagram
5. Understanding the principles of mechanization of foundries with their layouts and purchase of suitable layout

Mapping of Course Outcomes with Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2				2							
CO2	2		2									
CO3	2		3		3							
CO4	2											
CO5	2				2							

MEPE E03 OIL HYDRAULICS AND PNEUMATICS

Production Engineering
Elective

Lectures / Week: 4 periods

Course Objectives:

1. To understand the concepts of power transmission systems
2. Able to identify the components of hydraulic and pneumatic systems
3. Able to learn the concepts and to built different hydraulic and pneumatic circuits for different engineering applications

Course Content:

UNIT-I

Introduction

Functional requirements of a power transmission, different type of power transmission systems and their combinations; Fundamentals of oil hydraulics and pneumatics, Control functions of oil hydraulic systems; Comparison between Mechanical, Oil Hydraulic, Pneumatic and Electrical power transmission systems; Advantages, disadvantages and Applications of Oil Hydraulic and Pneumatic power transmissions.

UNIT-II

System Components

Hydraulic & Pneumatic Symbols as per ISO/ANSI, Properties and selection of hydraulic fluids, Filtration, Hydraulic Reservoirs and Accumulators, Intensifiers or Pressure Boosters, Seals and Packing.

UNIT-III

Oil Hydraulic Pumps and Actuators

Construction, working principle and operation of rotary & reciprocating pumps like Gear, Vane, Generated-Rotor, Screw, Axial Piston, Radial Piston, Pump characteristics, Specifications and selection of pumps; Linear actuators like Ram type, Telescopic and Single acting/double acting, types of their constructions, types of mountings, cylinder materials, cushioning of hydraulic cylinders, Rotary actuators, specifications, sizing and selection of pumps and actuators.

UNIT-IV

Control Valves

Construction, working principle and operation of Direction control valves, Flow control valves and Pressure control valves; including Check, Pressure relief, Compound Pilot operated Pressure Relief, Safety, Sequence, Pressure Reducing, Unloading, Counterbalance valves. Different types of center positions of DCVs, Methods of actuation of DCVs.

Hydraulic and Pneumatic Controllers used in Feedback Control systems

Construction, working principle and operation of Proportional and Servo control valves including Servo-type DCV like nozzle valve, flapper type valve, mechanical servo valve, single and double stage servo valves; Applications of servomotor systems in feedback control systems.

UNIT-V

Hydraulic Circuits

Reciprocation, quick return, sequencing, flow control circuits, synchronizing circuits, accumulator circuits, industrial circuits like press circuits, machine tool circuits, forklift, earth mover circuits- design and selection of components.

Pneumatic circuits

Compressed air production and distribution, pneumatic control components, examples of application including electro-pneumatic and hydro pneumatic controls.

REFERENCES:

1. Industrial Hydraulics by John Pippenger and Tyler Hicks, McGraw Hill.
2. Oil Hydraulic Systems, Principle and Maintenance by S R Majumdar, McGraw-Hill.
3. Fluid Power with Applications by Anthony Esposito, Pearson.
4. Fluid Power: Generation, Transmission and Control, Jagadeesha T., Thammaiah Gowda, Wiley.
5. The Analysis & Design of Pneumatic Systems by B. W. Anderson, John Wiley.
6. Control of Fluid Power Analysis and Design by Mc Clay Donaldson, Ellis Horwood Ltd.
7. Hydraulic and Pneumatic Controls: Understanding made Easy, K.Shanmuga Sundaram, S.Chand & Co Book publishers, New Delhi, 2006 (Reprint 2009)
8. Basic Pneumatic Systems, Principle and Maintenance by S R Majumdar, McGraw-Hill.
9. Basic fluid power Dudley, A. Pease and John J. Pippenger, , Prentice Hall, 1987

Course Outcome:

At the end of the course student will be able to learn the-

1. Identify and analyze the functional requirements of a power transmission system for a given application. (Application involving fluid power transmission)
2. Design an appropriate hydraulic or pneumatic circuit or combination circuit like electro-hydraulics, electro-pneumatics for a given application. Develop a circuit diagram.
3. Visualize how the hydraulic/pneumatic circuit will work to accomplish the function.
4. Selection and sizing of components of the circuit

Mapping of Course Outcomes with Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		3									
CO2	2	2	2	2								
CO3	2		2									
CO4	2		3									

MEPE E04 METROLOGY AND COMPUTER AIDED INSPECTION

Production Engineering
Elective

Lectures / Week: 4 periods

Course Objectives:

1. To impart the knowledge of metrology and different types of measurement systems with help of computers.
2. To impart the knowledge about the various measuring instruments to measure the linear, angular, form and surface finish measurements.
3. To introduce the applications of laser in the field of metrology, quality control and inspection.

Course Content:

UNIT-I

Metrological concepts — Abbe's principle, Need for High Precision Measurements problems associated with high precision measurements. Standards for length measurement — Shop Floor Standards and their Calibration — light Interference — Method of coincidence — Slip gauge calibration — Measurement errors. Various tolerances and their specifications, Gauging Principles Selective Assembly, Comparators.

UNIT-II

Angular measurements — Principles and instruments. Thread measurements. Surface and Form Metrology, Flatness, Roughness, Waviness, Roundness, Cylindricity, etc.

UNIT-III

Computer Aided Metrology — Principles and Interfacing Software Metrology.

UNIT-IV

Laser Metrology — Application of lasers in precision measurements, Laser Interferometer, Speckle Measurements, Laser Scanners.

UNIT-V

Coordinate Measuring Machine — Types of CMM. Probes used — Application — Non control CMM using Electro optical sensors for dimensional metrology Non — contact sensors for surface finish measurements. Signal analysis — Image processing and its application in metrology.

REFERENCES

1. S.A.J.Parsons, Metrology and Gauging, Mc Donald and Evans, UK, 1970
2. K.J. Hume, Engineering Metrology, Kalyani Publishers, INDIA, 1970
3. U. Rembold et aT, Computer Integrated Manufacturing Technology and Systems,Marcel Dekker Inc., USA, 1985.
4. S.L.Robinson and R.K.Miller, Automated Inspection and Quality Assurance, Marcel Dekker Inc. USA, 1989.

Course Outcomes:

At the end of the course student will be able to learn the-

1. Metrology, quality control and Inspection so that they can meet the challenges in the industries.
2. Various instruments and measuring systems with the help of laser and other advanced computer integrated systems.
3. Students will be able to measure any type of features, forms with the help of CMM.

Mapping of Course Outcomes with Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2				2						
CO2	3	1			4							
CO3	3	2										

MEPE E05 EXPERT SYSTEMS IN MANUFACTURING

Production Engineering
Elective

Lectures / Week: 4 periods

Course Objectives:

1. Able to understand the concepts of Artificial Intelligence and expert systems
2. To learn, how to represent knowledge and interface in manufacturing application

Course Content:

UNIT-I

Artificial Intelligence & Expert Systems, (Knowledge based systems); Definition — Justification — Structure Knowledge acquisition; Knowledge base, Inference engine, User interface, Explanatory module, Forward and backward chaining

UNIT-II

Knowledge representation and inferencing. Building expert systems Suitability of task, architecture, hardware, software, personnel — Expert system building tools language, shells.

UNIT-III

Commercial software for manufacturing applications in CAD, CAPP, MRP, CAM, MRP II, Adaptive control of devices, Robotics, Process control, Fault diagnosis, Failure analysis etc.;

UNIT-IV

Linking expert systems to other software such as DBMS, MIS, MDB, Process control and office — automation.

UNIT-V

Case studies of typical applications in process planning tool selection, cutting tool selection, part classification, inventory control, facilities planning, etc. The IITM rule selection.

REFERENCES

1. Adodji. B, BAd1I. N Expert System Applications in Engineering & Manufacturing —John Wiley & Sons(I 995)
2. Peter Jackson Introduction to Expert Systems.
3. Martin Merry Expert System — 85.

Course Outcomes:

At the end of the course student will be able to learn the-

1. Fundamental theories, concepts, and applications of computer science in solving real-time problems.
2. Able to Demonstrate working knowledge of reasoning in the presence of incomplete and/or uncertain information.
3. Ability to apply knowledge representation, reasoning, and machine learning techniques to real-world problems.
4. Able to solve the problems in the field of machining, inventory control, process planning with the help of expert systems.

Mapping of Course Outcomes with Program Outcomes:

	PO1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PO1 2
CO1		3										
CO2		2	2	3								
CO3		3	2	3								
CO4		2										

MEPE E06 ADVANCED WELDING PROCESSES

Production Engineering
Elective

Lectures / Week: 4 periods

Course Objectives:

1. Able to perform different weldability testing for different metals.
2. To understand the application of preheat and PWHT of weld joints in industry
3. Able to apply the knowledge about various methods for increasing service life of equipments

Course Content:

UNIT-I

General survey and classification of welding processes. Conventional gas welding and cutting. Manual metal arc welding. Electrode coverings and their functions. Continuous processes based on above.

UNIT-II

Submerged arc welding — types of fluxes and their compounding Wire and strip electrodes. Gas shielded welding TIG and MIG and MAG/ C02processes. Consideration of shielding gases, electrode polarity, current setting, metal transfer and arc length control. Plasma welding and cutting processes. Equipment maintenance, application of the above.

UNIT-III

Electrical power sources for welding; General characteristics of transformer, transformer — rectifier and motor generator sets. Use of pulsed currents. Pressure welding processes Solid phase bonding, friction welding, ultrasonic welding.

UNIT-IV

Explosive welding, Diffusion bonding and adhesive bonding. Resistance welding Spot, Seam and projection welding, Flash and upset butt welding.

UNIT-V

Brazing and soldering Electron Beam, Laser and Infrared Welding. Principles, Operational details, Process controls and application of above processes.

REFERENCES

1. The Science and Practice of Welding by Davies, A.C., Cambridge Low Price Edition
2. Welding Processes by Houldcroft, P. T., PHI Publications
3. Welding Technology by Konigsberger, F. Mc Graw Hill Publications
4. Welding and Welding Technology by Little, Richard L , TATA Mc Graw Hill Publications.
5. Welding Engineering by Rossi, Boniface E, PHI, Publications
6. Advanced Welding Systems. Vol.1 ; Vol.2 and Vol.3 by Jean Cornu, USA Edition.

Course Outcomes:

At the end of the course student will be able to learn the-

1. Weldability and perform different weldability testing for different metals.
2. Different dissimilar metal and its cladding.
3. Application of preheat and PWHT of weld joints as per codes and standards used in fabrication industry.
4. Knowledge about different methods for increasing service life of equipment.

Mapping of Course Outcomes with Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3				2							
CO2	3		2		2							
CO3	3	2	2		2							
CO4	3				2							

MEPE E07 METAL FORMING TECHNOLOGY

Production Engineering
Elective

Lectures / Week: 4 periods

Course Objectives:

1. To understand the characteristics of different processes
2. Able to solve the problems arising in metal forming technology
3. Able to analyze the design requirements of drawing and extrusion processes

Course Contents:

UNIT-I

Characteristics of presses types of drives of crank, eccentric, knuckle joint, rocker arm, non — geared and geared fly wheel type number of suspensions, use of counterbalances etc. Types of friction screw presses — 3 wheel, 4 — wheel vinunt, percussion, Belta drive, electric and hydraulic screw drives.

UNIT-II

Input — output balance diagrams of these drives. Characteristics and stroke rating of these machines. Horizontal forge machine, press frame design, guides.

UNIT-III

Fundamental theories of plasticity and mechanics of plastic deformation equations, methods for solution of problems in metal formation processes.

UNIT-IV

Fluid power in metal forming and related machine tools. Introduction of symbols, pumps, accumulators, valves. Classification of hydraulic presses extrusion, forging and deep drawing presses — design features — choice of fluid in hydraulic presses.

UNIT-V

Column design in hydraulic presses. Comprehensive design analysis of a deep drawing press and extrusion press. Hammers for hammer forgings. Classification based on action, stands, controls, and power medium. Theoretical principles involved in estimating efficiency of hammer, number of strokes, and power variation during — a play hammer..

REFERENCES

1. Row., Metal Forming Technology
2. Crane, Press Working of Metals, John Weliy & Sons; 1957

Course Outcomes:

At the end of the course student will be able to learn the-

1. Metal forming fundamentals and applications.
2. Metal forming mechanics.
3. Workability of testing techniques.
4. Tribology in metal forming and other phenomena

Mapping of Course Outcomes with Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO2	3		2		2							
CO3	3		2		2							
CO4	3				2							

MEPE E08 FINITE ELEMENT METHOD

Production Engineering
Elective

Lectures / Week: 4 periods

Course Objectives:

1. Possess a good understanding of the theoretical basis of the weighted residual Finite Element Method.
2. Be able to implement the Galerkin residual weak formulation into the Finite Element Method for the solution of Ordinary and Partial Differential Equations, using mathematical software such as Maple.
3. Able to know various applications solid mechanics, heat transfer and fluid mechanics

Course Content:

UNIT-I

Overview of FEM: Basic concepts – Historical background – General applicability of methods – one dimensional heat transfer, fluid flow, solid bar under axial load – Engineering applications of finite element method – general procedure in FEM – comparison of FEM and other methods of solutions.

UNIT-II

Approximate methods of Analysis: Methods of Weighted residuals – point collocation – Collection of sub-regions – least squares - Galerkin method, - Rayleigh`s method, Rayleigh – Ritz method, Ritz method, FDM

Discritization of Domain: Introduction to discritization of Domain – Basic element shapes – Descritization process – Types of elements and sizes – Finite representation of bodies – Node Numbering scheme – Automatic mesh generation methods –

UNIT-III

Interpolation methods: Introduction to interpolation polynomials – Polynomial forms of interpolation functions – Simplex, complex and multiplex elements – interpolation polynomial in terms of nodal degrees of freedom – Selection of order of interpolation polynomial – Convergence requirements – linear interpolation polynomials in terms of global co-ordinates - interpolation polynomials in terms of local co-ordinates

UNIT-IV

Higher Order and Isoparametric elements: Higher order one dimensional elements – Higher order elements in terms of natural coordinates - Higher order elements in terms of interpolation polynomials – One Dimensional elements and two dimensional elements using classical interpolation polynomials – comparative studies of elements – Isoparametric elements - shape function in co-ordinate transformation – continuity and compatibility – Numerical integration

UNIT-V

Applications in solid mechanics: Introduction - Plane stress – Plain strain rectangular element – Isoparametric formulation – Axisymetric stress analysis

Applications in heat transfer: Introduction – One dimensional heat conduction : quadratic element – One dimensional heat conduction with convection

Applications in fluid mechanics: Introduction – Governing equation for incompressible flow : Rotational and Irrotational.

REFERENCES:

1. Finite element method in Engineering – SS. Rao, Edition 4, Elsevier Publications, 2004
2. Fundamentals of Finite Element Analysis, David V. Hutton., Mc Graw Hill Publications, 2004
3. An Introduction to Finite Element Method , Reddy J.N., Mc Graw Hill Publications
4. Introduction to Finite Elements in Engineering:Chnandrupatla T.R.& Belegundu A.D, pearson education publishers, 4th edition. 2009
5. Finite Element Procedures, Klaus-Jurgen Bathe, Prentice Hall Professional, Revised Edition.1995.

Course Outcomes:

At the end of the course student will be able to learn the-

1. Able to design, set up, and conduct engineering experiments and analyze the results.
2. An ability to carry out projects and research in interdisciplinary areas.
3. Graduates will possess managerial and leadership skills with professional ethical practices and will understand the proper use of technical papers, copyrights and patents, recent advances in Finite Element Method field.
4. Able to understand the impact of Finite Element Method solutions in a global, economic, environmental, and societal context by participating at national level competitions like technical paper presentation, quiz programs, essay writing competitions, Industrial tours, Alumni association.
5. Recognition of the need for, and an ability to engage in lifelong learning and comprehend the current professional issues.

Mapping of Course Outcomes with Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2			2							
CO2	3	3	2		2							
CO3	3	2	2		2							
CO4	3				2							
CO5	3				2							

MEPE E09 ENERGY MANAGEMENT

Common to Industrial Engineering & Production Engineering
Elective

Lectures / Week: 4 periods

Course Objectives:

1. Familiarizing with management, especially with management in energy sector engineering.
2. Studying methods of energy accounting and energy auditing in energy sector, industry and final consumption.
3. Able to understand the fundamentals of product strategy management and Finding opportunities to increase the rational use of alternative energies.

Course Content:

UNIT-I

Introduction: Principles of energy management. Managerial organization, Functional areas for i) manufacturing industry, ii) Process industry, iii) Commerce, iv) Government, Role of Energy manager in each of these organizations. Initiating, Organizing and managing energy management programs

UNIT-II

Energy Audit: Definition and concepts. Types of energy audits, Basic energy concepts, Resources for plant energy studies. Data gathering, Analytical techniques. Energy Conservation: Technologies for energy conservation, Design for conservation of energy materials, Energy flow networks. Critical assessment of energy usage. Formulation of objectives and constrains, Synthesis of alternative options and technical analysis of options. Process integration.

UNIT-III

Economic Analysis: Scope, Characterization of an investment project. Types of depreciation, Time value of money. Budget considerations, Risk analysis.

UNIT-IV

Alternative Energy Sources:

Solar Energy – Types of devices for Solar Energy Collection – Thermal Storage System – Control Systems-

Wind Energy – Availability – Wind Devices – Wind Characteristics – Performance of Turbines and systems.

UNIT-V

Bio-Mass: Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield,combustion characteristics of bio-gas, utilization for cooking, I.C.Engine operation and economic aspects.

Geothermal Energy: Resources, types of wells, methods of harnessing the energy, potential in India.

Ocean Energy: OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles

REFERENCES:

1. Energy Management Hand Book / W.C. Turner (Ed)
2. Renewable Energy Sources fTwideil & Weir
3. Solar Energy /Sukhatme
4. Energy Management Principles / CB Smith/ Pergamon Press
5. Energy Management / W.R.Murthy and G.Mc.Kay / BS Publication
6. Management / H.Koontz and Cyrill Donnel / McGraw Hill
7. Rai G.D. : Non-conventional Energy Sources, Standard Publishers Distributors

Course Outcomes:

At the end of the course student will be able to learn the-

1. Understanding basics of demand side management and mechanisms (technical, legal or financial) that influence energy consumption.
2. Recognizing opportunities for increasing rational use of alternative energies.
3. Learning the basics of energy auditing with application on different sectors.
4. Able to take the decisions in budget estimations and evaluate risk analysis

Mapping of Course Outcomes with Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2		2									
CO2	3		3		1							
CO3	2		2									
CO4	1		3									

MEPE E10 DESIGN FOR MANUFACTURING

Common to Industrial Engineering & Production Engineering
Elective

Lectures / Week: 4 periods

Course Objectives:

1. Understand the design rules and considerations with reference to various manufacturing processes
2. To discusses capabilities and limitations of each manufacturing process in relation to part design and cost
3. To examine DFM principles including how the design affects manufacturing cost, lean manufacturing, six sigma, etc.

Course Content:

UNIT-I

Introduction: Design philosophy-steps in design process-general design rules for manufacturability-basic principles of designing for economical production-creativity in design.

Machining processes: Overview of various machining processes-general design rules for machining-dimensional tolerance and surface roughness-Design for machining – ease – redesigning of components for machining ease with suitable examples. General design recommendations for machined parts.

UNIT-II

Metal casting: Appraisal of various casting processes, selection of casting process,-general design considerations for casting-casting tolerance-use of solidification, simulation in casting design-product design rules for sand casting.

UNIT-III

Metal joining: Appraisal of various welding processes, factors in design of weldments – general design guidelines-pre and post treatment of welds-effects of thermal stresses in weld joints-design of brazed joints. Forging: Design factors for forging – closed die forging design – parting lines of dies – drop forging die design – general design recommendations.

UNIT-IV

Extrusion & Sheet metal work: Design guide lines extruded sections-design principles for punching, blanking, bending, deep drawing-Keeler Goodman forging line diagram – component design for blanking.

UNIT-V

Plastics: Visco elastic and creep behavior in plastics-design guidelines for plastic components-design considerations for injection moulding – design guidelines for machining and joining of plastics.

REFERENCES:

1. Design for manufacture, John cobert, Adisson Wesley. 1995
2. Design for Manufacture by Boothroyd,
3. Design for manufacture, James Bralla
4. ASM Hand book Vol.20

Course Outcomes:

At the end of the course student will be able to learn the-

1. Design components for machining
2. Simulate the casting design and choose the best casting process for a specific product.
3. Evaluate the effect of thermal stresses in weld joints
4. Design components for sheet metal work by understanding in depth the sheet metal processes and their formation mechanisms
5. Design plastic components for machining and joining and selecting a proper processes for different joining cases

Mapping of Course Outcomes with Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3									
CO2	2	2	2	2								
CO3	2		2									
CO4	2		3									
CO5	2		3									

MEIE E09 DESIGN AND ANALYSIS OF EXPERIMENTS

Common to Industrial Engineering & Production Engineering
Elective

Lectures / Week: 4 periods

Course Objectives:
1. Able to know the basic principles of design of experiments, ANOVA
2. able to understand the concept of 2k design and 2k-p fractional factorial design
3. Able to learn basics of robust, Taguchi designs and responses in surface methodology

Course Content:
UNIT-I

Introduction to design of experiments: Background and overview, A brief history of Design of Experiments (DOE), Overview of basic statistical concepts, Basic principles of DOE and Types and purpose of DOE methods.

UNIT-II

Full factorial Design: The basic “full factorials”, ANOVA, Factorial effects and plots, and Model evaluation.

UNIT-III

Fractional Factorial Design: The one-half fraction and one-quarter of the 2k design, The general 2k-p fractional factorial design and Resolution III, IV and V designs.

UNIT-IV

The Robust Design: The basics of robust designs, Taguchi designs and Robust design example.

UNIT-V

Response Surface Methodology – Central composite designs, Box-Behnken design, Analysis of second order response surfaces and process optimization.

REFERENCES:
1. Design and Analysis of Experiments, 5th edition, by D.C. Montgomery, John Wiley & Sons, New York, 2001.
2. Design of experiments using Taguchi approach, Ranjith K Roy, John Wiley & Sons.

Course Outcomes:
At the end of the course student will be able to learn the-
1. Formulate objective(s) and identify key factors in designing experiments for a given problem.
2. Develop appropriate experimental design to conduct experiments for a given problem.
3. Analyze experimental data to derive valid conclusions.
4. Optimize process conditions by developing empirical models using experimental data.
5. Design robust products and processes using parameter design approach.
6. **Mapping of Course Outcomes with Program Outcomes:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		2									
CO2	2	3	3									
CO3	3	2	3									
CO4	2		3									
CO5	3		2									

MEIE E10 PRODUCTIVITY ENGINEERING MANAGEMENT

Common to Industrial & Production Engineering
Elective

Lectures / Week: 4 periods

Course Objectives:

1. To know the basic definition and concepts of diversity and the difference between productivity and efficiency for economic growth.
2. To understand the various parameters and variables those influence the productivity and model the system performance on computers and measurements the output.
3. To know the long & short term productivity models based on technology and improvement for achievement of management goals

Course Content:

UNIT-I

Basic definitions and Scope — Significance of Productivity in economic development. Productivity measurement at nation level. Benefits of higher productivity at firm level. Diversity of productivity concepts.

UNIT-II

Productivity measurement models — Partial Productivity models, the multi — factor productivity Computers for productivity measurement. Productivity Evaluation Productivity Models, Total Model, Objectives Matrix. Expression for Total Productivity change, the Productivity Evaluation Tree.

UNIT-III

Productivity Planning — Long and Short Term Productivity models — Causes of low productivity in companies — Various strategies for productivity improvement. The Analytical Productivity Model.

UNIT-IV

Productivity Management at Enterprise level — Productivity Improvement Techniques — Technology based, Materials based, Product based, employee based and cost based. Productivity in service industries

UNIT-V

Case Studies, R&D Productivity, Evaluation of R&D, productivity, Technology Transfer.

References

1. Sumanth David, J., Productivity Engineering and Management — Mc Grawhill Book(1984)
2. Scott, Sink, D., Productivity Management Planning, Measurement and evaluation, control and Improvement.

Course Outcomes:

At the end of the course student will be able to learn the-

1. Identification and formulation productivity measurement at national level with diversity concepts
2. Development of suitable software for productive evaluation based on objective matrix and decision tree
3. Identification of long term and short term productive models in industry for improvement of the productivity
4. University-industry interaction for entrepreneurship development and technology transfer

Mapping of Course Outcomes with Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2		2									
CO2	3		3		2							
CO3	2		3		1							
CO4	1											

MEOE T01 PROJECT MANAGEMENT

Common to Industrial Engineering & Production Engineering
Open Elective

Lectures / Week: 4 periods

Course Objectives:

1. To understand the basic concepts of projects, need of projects, project life cycle and knowledge for management
2. To understand the project planning concepts, feasibility studies so as to design a project to achieve break-even point
3. To understand the roles of individual and team work leadership styles, challenges in project improvementation identify the conflict issues and solution process for better execution and control

Course Content:

UNIT-I

Basics of Project Management: Introduction, Need for Project Management, Project Management Knowledge Areas and Processes, The Project Life Cycle, The Project Manager (PM), Phases of Project Management Life Cycle, Project Management Processes, Impact of Delays in Project Completions, Essentials of Project Management Philosophy, Project Management Principles

UNIT-II

Project Identification and Selection: Introduction, Project Identification Process, Project Initiation, Pre-Feasibility Study, Feasibility Studies, Project Break-even point

Project Planning: Introduction, Project Planning, Need of Project Planning, Project Life Cycle, Roles, Responsibility and Team Work, Project Planning Process, Work Breakdown Structure (WBS)

UNIT-III

Organisational Structure and Organisational Issues: Introduction, Concept of Organisational Structure, Roles and Responsibilities of Project Leader, Relationship between Project Manager and Line Manager, Leadership Styles for Project Managers, Conflict Resolution, Team Management and Diversity Management, Change management

UNIT-IV

Project Performance Measurement and Evaluation: Introduction, Performance Measurement, Productivity, Project Performance Evaluation, Benefits and Challenges of Performance Measurement and Evaluation, Controlling the Projects

UNIT-V

Project Execution and Control: Introduction, Project Execution, Project Control Process, Purpose of Project Execution and Control

REFERENCES:

1. Effective project management by Robert K. Wysoki

Course Outcomes:

At the end of the course student will be able to learn the-

1. Better understanding of the project principles and project life cycle so as to avoid the project delays and the design stage itself to arrive at the Break-even point
2. Better analysis of the project planning, the role and responsibility of the team work in the assignment of jobs
3. Organization structure the responsibilities and role of leaders and team management
4. Process of implementation of performance measurements for better productivity and project process control

Mapping of Course Outcomes with Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2			3							
CO2	3	3			2							
CO3	3											
CO4	3											

MEOE T02 NON CONVENTIONAL ENERGY SOURCES

Common to Industrial Engineering & Production Engineering
Open Elective

Lectures / Week: 4 periods

Course Objectives:

1. To understand and analyze the present and future energy demand of nation so as to develop suitable techniques to tap the non conventional energy sources.
2. To understand the required equipments and instruments for installation of energy plants.
3. To know the concepts and selection of fuel cells for harnessing the energy in local conditions.

Course Content:

UNIT-I

Introduction: Role and potential of new and renewable sources – The solar energy option – Environmental impact of solar power.

Principles of Solar Radiation: Physics of the sun – The solar constant – Extraterrestrial and Terrestrial solar radiation – Solar radiation on tilted surface – Instruments for measuring solar radiation and sun shine – Solar radiation data.

UNIT-II

Solar Energy Collection: Flat plate and concentrating collectors – Classification of concentrating collectors – Orientation and Thermal analysis – Advanced collectors.

Solar Energy Storage: Different methods – Sensible, Latent heat and Stratified storage – Solar Ponds

Solar Applications: Solar heating/cooling techniques – Solar distillation and drying - Photovoltaic energy conversion.

UNIT-III

Wind Energy: Sources and potentials – Horizontal and Vertical axis windmills – Performance characteristics.

Bio-Mass: Principles of Bio-conversion – Anaerobic/Aerobic digestion – Types of Bio-gas digesters – Gas yield – Combustion characteristics of bio-gas – Utilization for cooking, I.C. engine operation – Economic aspects.

UNIT-IV

Geothermal Energy: Resources – Types of wells – Methods of harnessing the energy – Potential in India.

OTEC: Principles – Utilization – Setting of OTEC plants - Thermodynamic cycles.

Tidal and Wave Energy: Potential and Conversion techniques – Mini-hydel power plants – Their economics.

UNIT-V

Direct Energy Conversion: Need for DEC – Carnot cycle – Limitations – Principles of DEC – Thermo-electric generators – Seebeck, Peltier and Joule Thompson effects – Figure of merit – Materials – Applications – MHD generators – Principles – Dissociation and Ionization – Hall effect – Magnetic flux – MHD accelerator – MHD engine – Power generation systems – Electron gas dynamic conversion – Economic aspects

Fuel Cells: Principle – Faraday's laws – Thermodynamic aspects – Selection of fuels and Operating conditions.

REFERENCES:

1. Non-conventional Energy Sources : Rai G.D.
2. Non-conventional Energy : Ashok V Desai
3. Non-conventional Energy Systems : Mittal K M
4. Renewable Energy Technologies : Ramesh and Kumar
5. Renewable Energy Sources : Twidell and Weir
6. Solar Energy : Sukhame
7. Solar Power Engineering : Magal Frank Kreith B.S. & Kreith J.F.
8. Principles of Solar Energy : Frank Krieth and John F Kreider

Course Outcomes:

At the end of the course student will be able to learn the-

1. Need and analysis of non-conventional energy sources and the processes of energy conservation.
2. Harnessing the solar energy, storage devices so as to produce electricity; ways for energy distribution.
3. Understand the issue of fuel availability and analyse the supply and demand of fuel at the national level
4. Comparison of the coal-fired power plant with the non-conventional energy utilization to reduce environmental pollution.
5. Working principle of carnot cycle for maximum efficiency, need for power generation systems with thermodynamic concepts.

Mapping of Course Outcomes with Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		2									
CO2	3		3		2							
CO3	3				3							
CO4	3											
CO5	3											