SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI -517502

(AUTONOMOUS)

DEPARTMENT OF MECHANICAL ENGINEERING

(Choice Based Credit System)

R23

POST GRADUATION PROGRAM

MASTER OF TECHNOLOGY
in
PRODUCTION ENGINEERING

Scheme of Instructions and Evaluation
(With effect from the Academic Year 2023-24)

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI - 517 502
DEPARTMENT OF MECHANICAL ENGINEERING-SCHEME OF INSTRUCTION- (CBCS) EFFECTIVE FROM THE ACADEMIC YEAR: 2023-2024

M.TECH (PG) SPECIALIZATION: PRODUCTION ENGINEERING

I-SEMESTER

Category	Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
			Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
PCC	PE11C	Advanced Manufacturing Processes	3	1	0	4	4	40	60	100
PCC	PE12C	Advanced Material Technology	3	1	0	4	4	40	60	100
PCC	PE13C	Additive Manufacturing	3	1	0	4	4	40	60	100
PEC	PE14C	Programme Elective- I	3	0	0	3	3	40	60	100
PEC	PE15C	Programme Elective- II	3	0	0	3	3	40	60	100
PCC	PE16L	Production Engineering Lab - I	0	0	3	3	1.5	40	60	100
PCC	PE17L	CAD Lab	0	0	3	3	1.5	40	60	100
MAC	PE18C	Research Methodology and IPR	3	0	0	3	3	40	60	100
	Total		**18**	**3**	**6**	**27**	**24**	**320**	**480**	**800**

List of Programme Elective					
Course Title	**I**	**Applied Probability and Statistics**	**Operations Planning and Control**	**Advanced Casting Technology**	**Expert Systems in Manufacturing**
	II	**Robotics**	**Design for Manufacturing**	**Enterprise Resource Planning**	**Intelligent Manufacturing Systems**

SEMESTER - II

Category	Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
			Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
PCC	PE21C	Computer Integrated Manufacturing	3	1	0	4	4	40	60	100
PCC	PE22C	Cutting Tool Design and Precision Machine Tool Design Strategies	3	1	0	4	4	40	60	100
PEC	PE23C	Programme Elective Course - III	3	0	0	3	3	40	60	100
PEC	PE24C	Programme Elective Course - IV	3	0	0	3	3	40	60	100
PCC	PE25L	Production Engineering Lab - II	0	0	3	3	1.5	40	60	100
PCC	PE26L	CAM LAB	0	0	3	3	1.5	40	60	100
VAC	PE27C	Value Added course	2	0	2	4	3	100	-	100
PCC	PE28M	Mini Project with Seminar	1	1	0	2	2	100	-	100
	Total		**15**	**3**	**8**	**26**	**22**	**440**	**360**	**800**

List of Programme Elective					
Course Title	III	Automation in Manufacturing	Metal Forming Technology	Quality Control and Reliability Engineering	Finite Element Methods
	IV	Advanced Welding Processes	Oil Hydraulics and Pneumatics	Productivity Engineering & Management	Energy Management

Value Added course	I	II	III
Course Title	Leadership Qualities For Engineers	Stress Management	Universal Human Values

III- SEMESTER

Category	Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
			Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
OEC	PE31C	Open Elective Course ($MOOC_S$)	0	0	0	0	3	100	-	100
PCC	PE32I	Industrial/ Research Internship (Min of 4 Weeks)	0	0	0	0	3	100	-	100
PCC	PE33D	**Dissertation Work Phase-I**	0	0	24	24	12	40	60	100
	Total		**0**	**0**	**20**	**20**	**18**	**240**	**60**	**300**

IV- SEMESTER

Category	Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
			Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
PCC	PE41D	**Dissertation WorkPhase-II and Viva-Voce**	0	0	20	20	10 + 06 = 16	40	60	100
	Total		**0**	**0**	**20**	**20**	**16**	**40**	**60**	**100**

PE11C ADVANCED MANUFACTURING PROCESSES
M.TECH I SEMESTER
PRODUCTION ENGINEERING

Instruction Hours/ Week: (L-T-P-C): 3-1-0-4

COURSE CONTENT:

Unit – I

Why non – traditional machining processes (NTDM)? Classification of processes based on type and source of energy – AJM Process – AJM principle – Mechanics of AJM – Experimental setup – Components of AJM – Process Parameters – Metal removal rate (MRR) models in AJM – Applications, Advantages and Disadvantages.
USM Process – Principle and mechanics of USM – Mathematical model of USM – Construction and Working of USM process – USM unit – Abrasive slurry – Feed mechanism – process parameters – Applications, Advantages and Disadvantages.

Unit – II

ECM (Electrochemical Machining) – Chemistry of the process – Principle – Modelling of MRR – Kinematics and Dynamics of ECM – Major aspects of ECM tool design – process parameters and machined surface – ECM plant – Applications, Advantages and Disadvantages.
EDM process – Principle – Mechanics of EDM – Servomechanism – Sparking theory –RC circuit – EDM setup – Tool design – Process parameters – MRR and power delivered – Applications, Advantages and Disadvantages.

Unit – III

Wire – cut EDM process –General principles and applications of Wire EDM, Mechanics of metal removal, Process parameters – Surface roughness and kerf width.
Electron beam machining (EBM) – Main elements of EBM – Description – Power requirements and MRR – Mechanics of EBM – Process parameters of EBM –Applications, Advantages and Disadvantages.

Unit – IV

Plasma Arc Machining (PAM) –Non – transferred and transferred arcs – Components of PAM – Mechanism of MRR – Parameters of PAM – Various PAM processes – Applications and limitations.
Laser beam machining (LBM) – Lasing phenomenon – Solid lasers and gas lasers – Principle of LBM – Laser beam cutting – Analysis of laser cutting – Nd:YAG laser beam system – controlling parameters – Ruby crystal based LBM – Applications and limitations.

Unit – V

Surface engineering – What is surface engineering ?– Electroplating – Theory of electroplating – requirement of plating electrolyte Nickel plating– Electrochemical corrosion – Immersion plating – Electroless plating – Conversion coatings – oxide coatings, phosphate coatings, chromium coatings – Thin film coatings – PVD coating – CVD coating – Organic coatings – Thermal and Mechanical coating processes.

COURSE OUTCOMES:

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

1. Understand the Abrasive jet and ultrasonic machining process, applications, recent development, and limitations.
2. Analyze the influence of process parameters on the out responses of electrochemical andwire EDM processes.
3. Explain the Electron Beam and Plasma Arc machining with their principles, applications,and limitations.
4. Know the laser beam application for machining and understand the various surfaceprocess

operations.

5. Understand and apply the various processing techniques to fabricate ceramic materialsand 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 / 1st edition, PHI 1990.

PE12C ADVANCED MATERIAL TECHNOLOGY
M.TECH I SEMESTER
PRODUCTION ENGINEERING

Instruction Hours/ Week: (L-T-P-C): 3-1-0-4

COURSE CONTENT:

UNIT-I

Introduction of advanced materials: Principle of material for engineering applications and their manufacturability. Selection of Materials: Classification of materials, properties required in engineering materials

UNIT-II

Metallic Materials: Fundamental of metallic materials; Crystal structure of metals and alloys Strengthening mechanisms -Phase diagrams- Heat treatment processes -iron-carbon equilibrium diagrams-Advanced Steels and cast irons-Transformation hardening in steels TTT diagrams. Non-Ferrous Materials and High-Temperature Materials: Structure, physical metallurgy, manufacturability, and properties of Al, Mg, and Ti alloys.

UNIT-III

Composite Materials: Definition, Classification, Types of matrices & reinforcements, characteristics & selection, Fiber composites, laminated composites, particulate composites, pre-pregs, sandwich construction. Fabrication methods of in-situ, ex-situ, and Nano composites.

UNIT-IV

Mechanics of Composites: Introduction, Evaluation of the four elastic moduli – Rule of mixture, ultimate strengths of a unidirectional 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-V

Smart Materials: Introduction to smart materials. Principles, mechanisms, piezoelectric, magnetostrictive, electrostrictive, magnetorheological, electrorheological materials, smart gels. Shape memory alloys and Applications.

COURSE OUTCOMES:

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

1. Understand the Principle and Classification of engineering materials and their properties
2. Elaborate the phase diagrams of metallic materials and their properties
3. Analyze the Classification of composite materials along with their characteristics
4. Derive ultimate strengths of the unidirectional lamina and theories of failures in composites
5. Explain the Principle and mechanism of smart materials and their applications

REFERENCES:

1. Composite Materials handbook - Mein Schwartz - McGraw 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. W.D. Callister, Jr, - Material Science & Engineering Addition-Wesly Publishing Co.
5. Light Alloys: From Traditional Alloys to Nano Crystals- I.J. Polmear, Elsevier Publication.
6. Shape Memory Alloys- Corneliu Cismasiu, Sciyo Publication.
7. Smart Materials Fabrication and Materials for Micro-Electro-Mechanical Systems: Volume 276 (MRS Proceedings)" by George C Johnson and A Peter Jardine

PE13C ADDITIVE MANUFACTURING
M.TECH I SEMESTER
PRODUCTION ENGINEERING

Instruction Hours/ Week: (L-T-P-C): 3-1-0-4

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, Sim plant, Velocity2, VoXim, Solid View, 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: Photo polymerization RP Processes: Stereo lithography (SL), SL resin curing process, SL scan patterns, Micro stereo lithography, Applications of Photo polymerization Processes.

Powder Bed Fusion RP Processes: Stereo lithography (SL), SL resin curing process, SL scan patterns, Micro stereo lithography, Applications of Photo polymerization 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 modeling, 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.

COURSE OUTCOMES:

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

1. Understand the prototyping, TP vs. RP, RP classification, RP needs and solid view 3D view, and preparation of CAD models.
2. Describe Rapid Prototyping (RP) Processes with their principles, applications, Processing-structure-properties, relationships, Benefits, and drawbacks.
3. Select the rapid tooling methods with Soft and Hard Tooling methods
4. Understand the Reverse Engineering (RE) Methodologies and Techniques.
5. Analyze errors in RP processes and analyze applications of RP in the medical field.

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

PE14C APPLIED PROBABILITY AND STATISTICS
M.TECH I SEMESTER
COMMON TO INDUSTRIAL ENGINEERING & PRODUCTION ENGINEERING
(Programme Elective- I)

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

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, students will be able to

1. Understand the basic concept of probability.
2. Explain random variables for discrete and continuous probability estimation.
3. Define sampling theory, apply it to predict the event, and analyze the statistical distributions.
4. Analyse different Estimations and Testing of hypothesis
5. Apply the concepts of analysis of variance for the Correlation between the observed and experimental values.

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.

PE14C OPERATIONS PLANNING AND CONTROL

M.TECH I SEMESTER

COMMON TO INDUSTRIAL ENGINEERING & PRODUCTION ENGINEERING

(Programme Elective- I)

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

COURSE CONTENT:

UNIT-I

OPC is 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 cases, 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 programs. 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, and 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:

From this course, students will be able to

1. Describe Forecasting principles and techniques for short-range and long-range planning
2. Analyze Production requirements for each product and plan the shop floor activities
3. Elaborate Work station loading and scheduling of paths to avoid bottlenecks for smooth production
4. Design Solution for product mix decision using OR techniques.
5. Analyse Optimal job sequences to achieve the minimum makespan with maximum production

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.

PE14C ADVANCED CASTING TECHNOLOGY
M TECH I SEMESTER
PRODUCTION ENGINEERING
(Programme Elective- I)

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

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 resins; 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, attempt making. Chvorinov's rule, design of running and feeding systems; factors affecting the engineering 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

Non-ferrous 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 non-ferrous 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.

COURSE OUTCOMES:

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

1. Identify materials for moulding, additives, coating, and the methods of sand controls.
2. Analyze different furnaces for metal melting and design a suitable furnace depending on materials.
3. Explain the concepts related to the casting processes and the factors influencing the design process for metals and alloys.
4. Describe the properties of liquid metals and their compositions and attain the various alloys depending upon the temperature, Iron-carbon diagram.
5. Understand the principles of mechanization of foundries with their layouts and purchase of suitable plant layouts.

REFERENCES

1. Rosenthal et al., Principles of Metal Casting — Tata Mc Grawhill Publishers.
2. Ruddle Riser and Gating design
3. Murphy Non — ferrous Foundry Metallurgy
4. Tompkins and White Facilities planning — John Wiley & Sons.
5. Flinn Metal Casting — Prentice Hall India.
6. P. L. Jam Principles of Metal Casting — Tata McGraw-Hill
7. O. P. Khanna Foundry Technology — Khanna Publishers.

PE14C EXPERTSYSTEMS IN MANUFACTURING

M. Tech I SEMESTER

Common to Industrial Engineering & Production Engineering

(Programme Elective- I)

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

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.

COURSEOUTCOMES:

At the end of the course student will be able to

1. Understand the Knowledge based systems involving real-time problems.
2. Develop the expert systems
3. apply expert system software for manufacturing applications
4. Link the expert systems to other software.
5. Solve the problems in the field of machining, inventory control, process planning with the help of expert systems.

REFERENCES

1. Adodji.B,BAd1I.NExpertSystemApplicationsinEngineering&Manufacturing — JohnWiley&Sons(l995)
2. Peter JacksonIntroductiontoExpertSystems.MartinMerryExpertSystem—85

PE15C ROBOTICS
M TECH I SEMESTER
PRODUCTION ENGINEERING
(Programme Elective- II)

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

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 sensors – 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 – Offline and online programming – Manual programming, Lead through programming, robot programming languages—industrial applications of robots.

COURSE OUTCOMES:

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

1. Understand the fundamentals of robotics and its anatomy.
2. Analyze Robot Configuration and its controls.
3. Describe the Principles of robot programming and handle with a typical robot, control systems & sensors.
4. Analyze the Construction and working of robot components.
5. Design automatic manufacturing cells with robotic controls, robot kinematics, and programming.

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
4. Mikell P. Groover, Mitchell Weiss, Roger N. Nagel and Nicholas G. Odrey, "Industrial Robotics Technology, Programming and Applications," Mc Graw Hill Book Company, 1986
5. R.K. Mittal and I.J. Nagrath, "Robotics and Control," McGraw Hill Education (India) Private Ltd., 2014.
6. Gonzalez KSFURC and Lee C.S.G., "Robotics-Control, Sensing, Vision, and Intelligence" Mcgraw-Hill Book Company (July 1987).
7. Deb S.K, Deb,s "Robotics Technology and Flexible Automation", Tata McGraw-Hill Education Private Limited, 2009.
8. Ganesh S. Hegde, A textbook on Industrial Robotics, Laxmi Publications (P) Ltd., 2007.

PE15C DESIGN FOR MANUFACTURINGS

M TECH I SEMESTER

COMMON TO INDUSTRIAL ENGINEERING & PRODUCTION ENGINEERING

(Programme Elective- II)

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

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 the 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 guidelines 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 behaviour in plastics-design guidelines for plastic components-design considerations for injection moulding – design guidelines for machining and joining of plastics.

COURSE OUTCOMES:

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

1. Perceive the principles and steps for designing products for economical production.
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 and accessibility of welding processes.
4. Design components for sheet metal work by understanding the design guidelines and principles of sheet metal processes.
5. Design plastic parts for machining, joining, and selecting a proper method for different joining cases.

REFERENCES:

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

IE15C ENTERPRISE RESOURCE PLANNING

M.Tech I SEMESTER

Common to Industrial Engineering & Production Engineering

(Programme Elective- II)

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

COURSE CONTENT:

UNIT-I

Introduction to ERP: Enterprise – An Overview, Integrated Management Information, Business Modeling, Integrated Data Model

UNIT-II

ERP and Related Technologies Business Processing Reengineering (BPR), Data Warehousing, Data Mining, On-line Analytical Processing (OLAP), Supply Chain Management (SCM), Customer Relationship Management (CRM), MIS - Management Information System, DSS - Decision Support System, EIS - Executive Information System.

UNIT-III

ERP Manufacturing Prospective: MRP - Material Requirement Planning, BOM - Bill Of Material, MRP - Manufacturing Resource Planning, DRP - Distributed Requirement Planning, PDM - Product Data Management

UNIT-IV

ERP Modules Finance, Plant Maintenance, Quality Management, Materials Management

UNIT-V

Benefits of ERP Reduction of Lead-Time, On-time Shipment, Reduction in Cycle Time, Improved Resource Utilization, Better Customer Satisfaction, Improved Supplier Performance, Increased Flexibility, Reduced Quality Costs, Improved Information Accuracy and Design-making Capability

COURSE OUTCOMES:

At the end of the course student will be able

1. To understand the basic concept of enterprise resource planning (ERP).
2. To analyse the related technologies of business processing reengineering.
3. To apply the concept of MRP 1, MRP 2, BOM, DRP and PDM.
4. To develop the ERP models.
5. To understand the ERP reduction of timings and benefits.

REFERENCE BOOKS:

1. Enterprise Resource Planning - Alexis Leon, Tata McGraw Hill.
2. Enterprise Resource Planning – Diversified by Alexis Leon, TMH.
3. Enterprise Resource Planning - Ravi Shankar & S. Jaiswal ,Galgotia

PE15C INTELLIGENT MANUFACTURING SYSTEMS
M TECH I SEMESTER
PRODUCTION ENGINEERING
(Programme Elective- II)

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

COURSE CONTENT:

UNIT I:
Computer integrated manufacturing systems – structure and functional areas of CIM system - AD, CAPP, CAM, CAQC, ASRS and advantages of CIM Manufacturing communication systems – MAP/TOP OSI model, data redundancy, top-down and bottom-up approach, volume of information. Intelligent manufacturing – system components, system architecture and data flow, system operation.

UNIT II:
Components of knowledge-based systems – basic components of knowledge based systems, knowledge representation, comparison of knowledge representation schemes, interference engine, knowledge acquisition Machine learning – concept of artificial intelligence, conceptual learning, and artificial neural networks -biological neuron, artificial neuron, types of neural networks, applications in manufacturing.

UNIT III:
Automated process planning – variant approach, generative approach, expert systems for process planning, feature recognition, phases of process planning knowledge Based System for Equipment Selection (KBSES) – Manufacturing system design, equipment selection problem, modelling the manufacturing equipment selection problem, problem solving approach in KBSES, structure of the KBSES.

UNIT IV:
Group technology: models and algorithms – visual method, coding method, cluster analysis method, matrix formation – similarity coefficient method, sorting-based algorithms, bond energy algorithm, cost-based method, cluster identification method, extended ci method.

UNIT V:
Knowledge-based group technology - group technology in the automated manufacturing system, structure of knowledge-based system for group technology (KBSGT) – data base, knowledge base, clustering algorithm.

COURSE OUTCOMES:

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

1. Describe the performance of manufacturing systems.
2. Derive the systemic approach for designing and implementing manufacturing systems.
3. Analyse new procedures to improve productivity and existing manufacturing systems.
4. Explain and Analyse online collaboration tools to work in complex teams
5. Understand the group technology in automated manufacturing systems.

REFERENCES:

1. Andre Kusaic, “Intelligent Manufacturing Systems”, PHI, 1989.
2. Hamid R.Parsaei and Mohammad Jamshidi, “Design and Implementation of Intelligent Manufacturing Systems”, PHI, 2009.
3. Mikell P Groover, “Automation, Production Systems and Computer Integrated Manufacturing”, 8th edition, PHI, 2008.
4. Yagna Narayana, “Artificial neural networks”, PHI, 2009.

PE16L PRODUCTION ENGINEERING LAB –I
M TECH I SEMESTER

PRODUCTION ENGINEERING

Instruction Hours/ Week: (L-T-P-C): 0-0-3-3

COURSE CONTENT:

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 the Wedge method.
6. Study of Measuring Instruments
7. Sine bar
8. Sand analysis

COURSE OUTCOMES:

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

1. Perform Drill jig inspection.
2. Write CNC programming for turning and milling
3. Understand the working of measuring instruments
4. Perform profile and straightness measurements.
5. Utilize the sine bar and sand analysis for the casting process.

PE17L CAD LAB

M TECH I SEMESTER

Instruction Hours/ Week: (L-T-P-C): 0-0-3-3

COURSE CONTENT:

1) Modeling and analysis of machine parts using modeling and simulation packages.
2) Minimum of four exercises in structural and thermal analysis is to be carried out.
3) A case study has to be done by the each student.

COURSE OUTCOMES:

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

1. Understand the commands of CAD and CAE software's.
2. Able to analyse the structural problems and their solutions using CAE.
3. Able to analyse the thermal problems and their solutions using CAE..
4. Able to analyse manufacturing problems and simulation using the CAE software.
5. Able to apply CAD tools for design and manufacturing applications.

PE18C RESEARCH METHODOLOGY AND IPR
M.TECH I SEMESTER
PRODUCTION ENGINEERING

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

COURSE CONTENT:

UNIT-I

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

UNIT-II

Effective literature studies approaches, analysis, Plagiarism, Research ethics.

UNIT-III

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

UNIT-IV

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT. Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT-V

New Developments in IPR: Administration of Patent System. New developments in IPR, IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

COURSE OUTCOMES:

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

1. Understand research problem formulation.
2. Analyze research related information
3. Follow research ethics
4. Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

REFERENCES*:*

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & Engineering students"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition , "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
5. Mayall , "Industrial Design", McGraw Hill, 1992.
6. Niebel , "Product Design", McGraw Hill, 1974.
7. Asimov , "Introduction to Design", Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016.
9. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008.

PE21C COMPUTER INTEGRATED MANUFACTURING
M.TECH II SEMESTER
PRODUCTION ENGINEERING

Instruction Hours/ Week: (L-T-P-C): 3-1-0-4

COURSE CONTENT:

UNIT-I

Introduction: Scope of computer-integrated manufacturing, Product cycle, and 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 GT.

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, Overview of production control - Forecasting, Master production schedule, Rough – Cut Capacity planning, MRP, 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, and 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.

COURSE OUTCOMES:

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

1. Define the scope of integrated manufacturing in production.
2. Different Approaches of the planning process in CAPP and their benefits
3. Design a manufacturing cell and cellular manufacturing system
4. Understand the Importance of inspection methods in CAQC
5. Explain types of manufacturing systems and material handling in CIM

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.

PE22C CUTTING TOOL DESIGN AND PRECISION MACHINE TOOL DESIGN STRATEGIES

M.TECH II SEMESTER

PRODUCTION ENGINEERING

Instruction Hours/ Week: (L-T-P-C): 3-1-0-4

COURSE CONTENT:

Unit I

Machining principles: Cutting – Basic machine tool and the involved motions, cutting tool materials. Basic machining parameters, rate of metal removal, tool life, force and power requirements. Friction in metal cutting – Effect of friction.

Unit – II

Design of cutting tools: Types – single point and multi – point cutting tools – Design of a single point cutting tool – strength and rigidity criteria – Design of multi – point cutting tools – profile milling cutters, Drills, and Broach

Unit – III

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

Unit IV

Design strategy for standard size machines – Design methodology – Design principles – Steps in the design roadmap – Machine key components – Guideways and Bearings – Micromachines – Need for Miniaturization – Design Approach – Design challenges – Kinematics – Interactive forces and Actuators

Unit – V

Actuators – Electric Actuators and Electric Drives – Stepper motors, DC and AC motors – Mechanical Actuators – Friction drive design concepts – Lead screw and Ball Screw – Sensors – Position measurement – Encoders – Potentiometer – LVDT – Strain gauge – Velocity measurement – Acceleration measurement – Torque measurement.

COURSE OUTCOMES:

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

1. Describe cutting tool geometry and mechanism of chip formation.
2. Understand and explain merchant theory, Lee and Shaffer's theory
3. Understand the practical aspects of tool wear and tool life and their influence on economics

4. Analyze different types of tools and their applications
5. Describe macro and micro cutting and their characteristics.

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 MK tools, New Age India Pvt. Ltd. Publishers.

PE23C AUTOMATION IN MANUFACTURING

M.TECH II SEMESTER

PRODUCTION ENGINEERING

(Programme Elective Course – III)

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

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, and 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, Co-ordinate Measuring Machines, Machine Vision.

COURSE OUTCOMES:

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

1. Understand the various types of automation systems.
2. Solve the line balancing problems in the various flow line systems with and without the use of buffer storage
3. Analyze the different automated material handling, storage and retrieval systems, and automated inspection systems.
4. Utilization of Adaptive Control principles and implementing the same online inspection and control
5. Understand the fundamentals of automation inspection methods.

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

PE23C METAL FORMING TECHNOLOGY
PRODUCTION ENGINEERING
M.TECH SEMESTER II
(Programme Elective Course – III)

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

COURSE CONTENT:

UNIT-I
Characteristics of presses types of crank drives, 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 wheels, 4 — wheel Vincent, 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, and 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 the efficiency of a hammer, number of strokes, and power variation during — a play hammer.

COURSE OUTCOMES:

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

1. Understand Metal forming fundamentals and applications.
2. Analyze Metal forming mechanics.
3. Understand plastic deformation takes place in Metal forming
4. Application of Fluid hydraulics in Metal forming
5. Design analysis of presses and Explain hammer forging and its efficiency

REFERENCES

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

PE23CQUALITY CONTROL AND RELIABILITYENGINEERING

M.TECH I SEMESTER

PRODUCTION ENGINEERING

(Programme Elective Course – III)

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

COURSE CONTENT:

UNIT-I

Basic Concepts: Definitions of quality, Quality of design, Quality of conformance, and Quality of performance, Dimensions of quality, Quality characteristics, Quality control, Statistical quality control and cost of quality.

Fundamentals of Probability and Statistics: Events, Sample space, Probability rules, Dependent and Independent events, Statistical tools in quality control, Concept of variation, Graphical tools for data representation and analysis, Discrete and continuous probability distributions and their applications in quality control, numerical problems

UNIT-II

Control charts for Variables: Variation, Causes of variation, Objectives of control charts, Choice of variable, Subgroup size and sub grouping, frequency of sampling, control limits. Process capability analysis, Relationship of a process in control to specification limits, Variable charts - X bar chart, R chart, σ chart, revision of control limits and RPI, Introduction to custom chart and moving range charts, numerical problems.

UNIT-III

Control charts for Attributes: Control charts for fraction nonconforming (p chart, np chart) and nonconformities (c chart and u chart) with variable and constant sample size, Choice between variables and attributes control charts, revision of control limits, numerical problems.

Failure Data Analysis : Introduction, Failure Data, Quantitative measures, MTTF, MTBF, Bathtub Curve, Mean Life, Life Testing, numerical problems, Introduction to Failure Mode and Effect Analysis.

UNIT-IV

Acceptance Sampling: Fundamentals of acceptance sampling, Sampling methods, OC Curves and their characteristics, AQL, IQL, LTPD, AOQ/AOQL.

Types of acceptance sampling-Single, Double, Multiple, and Sequential sampling plans, Average Total Inspection, comparison amongst sampling plans, numerical problems.

UNIT-V

System Reliability: Definition, Series, parallel and mixed configuration, Block diagram concept, r-out-of-n structure solving problems using mathematical models. Difficulty in achieving reliability, Methods for improving reliability during design, Different techniques available to improve reliability, Reliability-Cost trade off, Prediction and Analysis, numerical problems.

Maintainability and Availability: Introduction, Techniques available to improve maintainability and availability, trade-off among reliability, maintainability and availability, Simple problems

COURSE OUTCOMES:

At the end of the course student will be able to

1. To understand basic concepts of quality control.
2. To apply the control charts of variables (X bar ,P bar charts) for different applications.
3. To apply the control charts of attributes (C bar ,N bar charts) and **conduct Failure Analysis**
4. To apply acceptance sampling plans for quality control.
5. Understand the concepts of reliability management, and **Maintainability and Availability:**

REFERENCES:

1. Fergenbaum,V. Armand, Total Quality Control — Tata MeGrawhill(40th Edition)
2. Besterfield H. Dale., Quality Control — A practical approach — Pearson Education Asia (2nd Edition).
3. Grant, E. L., Statistical Quality Control — Tata Mc Grawhill (6th Edition)
4. Montgomary — Statistical Quality Control — John Wiley & Sons
5. Srinath, L.S., Concepts in Reliability Engineering — Prentice Hall India.

PE23C FINITE ELEMENT METHODS
M.TECH II SEMESTER
PRODUCTION ENGINEERING
(Programme Elective Course – III)

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

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 solutions methods.

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

Discretization of Domain: Introduction to the discretization of Domain – Basic element shapes – Discretization 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 co-ordinates - Higher order elements in terms of interpolation polynomials, One-Dimensional elements, and two-dimensional elements using classical interpolation polynomials – comparative studies of elements – Iso parametric 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 –Axis- metric 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.

COURSE OUTCOMES:

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

1. Understand the General procedure of FEM and its applications
2. Elaborate on different analysis methods of FEM
3. Describe polynomial forms of interpolation
4. Evaluate high-order one-dimensional elements and iso parametric elements
5. Analyze the various applications of FEM in engineering.

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.

PE24C ADVANCED WELDING PROCESSES
M.TECH II SEMESTER
PRODUCTION ENGINEERING
(Programme Elective Course – IV)

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

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 the above.

UNIT-II
Submerged arc welding — types of fluxes and their compounding Wire and strip electrodes. Gas-shielded welding TIG and MIG and MAG/ CO_2 processes. 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, and 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 the above processes.

COURSE OUTCOMES:
At the end of the course, students will be able to

1. Understand the different weldability testings for different metals.
2. Describe the different types of welding and its applications.
3. Explain the electric power sources for welding and pressure welding processes.
4. Understand the different types of bondings and their advantages.
5. Distinguish between brazing and soldering and their applications.

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 3 by Jean Cornu, USA Edition.

PE24C OIL HYDRAULICS AND PNEUMATICS

M.TECH II SEMESTER

PRODUCTION ENGINEERING

(Programme Elective Course – IV)

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

COURSE CONTENT:

UNIT-I

Introduction

Functional requirements of power transmission, different types 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, Accumulators, Intensifiers or Pressure Boosters, Seals, and Packing.

UNIT-III

Oil Hydraulic Pumps and Actuators

Construction, the 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, and 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 valves, flapper-type valves, mechanical servo valves, 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.

COURSE OUTCOME:

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

1. Analyze the functional requirements of a power transmission system for a given application.
2. Understand the system components of Hydraulic and pneumatic symbols.
3. Design an appropriate hydraulic or pneumatic circuit, and develop a circuit diagram.
4. Describe the control valves and Hydraulic and pneumatic controller and their applications.
5. Design the hydraulic and pneumatic circuit and its selection.

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)

PE24C PRODUCTIVITY ENGINEERING & MANAGEMENT

M.TECH II SEMESTER

Common to Industrial Engineering & Production Engineering

(Programme Elective Course – III)

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

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.

COURSEOUTCOMES:

At the end of the course student twill be able to

1. Analyze the significance of productivity measurement at national level and firm level
2. Implement the Productivity measurement models.
3. Develop Productivity Planning
4. Apply Productivity Improvement Techniques
5. Carryout case studies of productivity improvement for entrepreneur ship development and technology transfer.

REFERENCES

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

PE24C ENERGY MANAGEMENT

M.TECH SEMESTER II

Common to Industrial Engineering & Production Engineering

(Programme Elective Course – IV)

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

COURSE CONTENT:

UNIT-I

Introduction: Principles of energy management. Managerial organization, Functional areas fori) 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, and Resources for plant energy studies. Data gathering, Analytical techniques. Energy Conservation: Technologies for energy conservation, design for conservation of energy materials, and Energy flow networks. Critical assessment of energy usage. Formulation of objectives and constraints, 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

COURSE OUTCOMES:

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

1. Describe the principles and functional area of energy management.
2. Learning the basics of energy auditing with applications in different sectors.
3. Evaluate risk analysis and decision estimations in budget.
4. Identify opportunities for increasing the rational use of alternative energies.
5. Analyze the biomass system, conversion, and utilization.

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

PE25L PRODUCTION ENGINEERING LAB –II
M.TECH II SEMESTER
PRODUCTION ENGINEERING

Instruction Hours/ Week: (L-T-P-C): 0-0-3-1.5

COURSE CONTENT:

LIST OF EXPERIMENTS:

1. Measurement of cutting forces using lathe tool dynamometer.
2. Measuring cutting forces using a drill dynamometer
3. To determine the major & minor flank angle of a particular screw by using the tool makers microscope.
4. To arrange the dividing head for differential indexing, to divide a circular part into a number of parts, using differential indexing.
5. Surface roughness measurement by using Talysurf
6. Measurement of cutting forces in milling
7. Spur gear measurement
8. Welding
9. To write a manual part program for the profile turning cycle to the given dimensions for a typical part.
10. To write the manual part program for the drilling operation

COURSE OUTCOMES:

At the end of the course student will be able to

1. Measure cutting forces using a dynamometer for the lathe, drilling, and milling machines, and arrange differential indexing.
2. The major and minor flank angles of the screw by using a toolmakers microscope
3. The surface roughness using Talysurf and Spur gear measurement
4. Perform welding and analysis
5. Part programming for the given typical part and manual part programming for the drilling operation

PE26L CAM LAB

M.TECH II SEMESTER

PRODUCTION ENGINEERING

Instruction Hours/ Week: (L-T-P-C): 0-0-3-1.5

COURSE CONTENT:

LIST OF EXPERIMENTS:

1. Preparation of process planning.
2. CNC programming using G & M codes for the given work piece & also shows the simulation using CNC lathe software.
3. Simulation & execution of a part program for a given component using CNC milling.
4. Fabrication of a component using CNC Lathe.
5. Fabrication of a component using CNC machining center.

Note: Conduct at least 8 Exercises in the above topics.

COURSE OUTCOMES:

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

1. Define the preparation o process planning.
2. Write a Program for a CNC lathe using G&M codes
3. Analyze the simulation of the CNC lathe process and execute a part program.
4. Write a Program for CNC milling using G&M codes
5. Analyze the simulation of CNC milling and execute a part program for a given component.

PE27C LEADERSHIP QUALTIES FOR ENGINEERS

M.Tech II Semester

Common to Industrial Engineering & Production Engineering

(Value Added Course)

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

COURSE CONTENT:

UNIT-I

Introduction to Leadership Roles, functions and characteristics of a leader, evolution and growth of leadership, Leadership traits and ethics, Attitude, Behavior, Personality traits and leadership, Types and Styles of leadership, Leader vs Manager, Essential qualities of an effective leader.

UNIT-II

Leadership and Management (Nature, Scope and Significance of Management, Levels of Management, Functions: Planning, Organizing, Staffing, Directing and Controlling, Skills: Conceptual, Human and Technical, Roles: Interpersonal, Informational and Decisional, difference between a leader and a manager)

UNIT-III

Types of Leaders, Leadership styles: Traditional, Transactional, Transformational, Inspirational and servant leadership and Emerging issues in leadership: Emotional Intelligence and leadership, Trust as a factor, Gender and Leadership.

UNIT-IV

Personality: Concept and Definition, Determinants of personality, Personality traits, Personality characteristics in organizations: Self-evaluation, Locus of control, Self-efficacy, Self-esteem, Self-monitoring: Positive and negative Impact.

UNIT-V

Self-Discovery (Awareness of personal values, beliefs and vision that motivates behavior, Personal SWOT, Trust: Openness, confidentiality, blind spot and unknown part of personality, Self-disclosure, seeking feedback, self-reflection, introspection and self-management.

COURSE OUTCOMES:

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

1. To understand the leadership roles.
2. To apply the concepts of Leadership and Management.
3. To understand and apply the concepts of Leadership styles.
4. Inculcate and apply personality development aspects.
5. To inculcate and create awareness.

REFERENCES:

1. Organizational Behaviour, M.Parikh and R.Gupta , Tata McGraw Hill Education Private Limited

2. Organizational Behavior, D. Nelson, J.C Quick and P. Khandelwal, Cengage Publication.

PE27C STRESS MANAGEMENT

M.Tech II Semester

Common to Industrial Engineering & Production Engineering

(Value Added Course)

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

COURSE CONTENT:

UNIT-I

Meaning and nature of stress: Difference between eustress and distress; Frustration, conflict and pressure; Meaning of stressors; common stressors at work place: Stressors unique to age and gender. Stress and Memory; Stress and Other Cognitive Variables; Stressful environmental conditions on performance.

UNIT-II

Behavioural aspects of Stress: Adaptive and Maladaptive Behaviour; Individual and Cultural Differences: Sources of Stress- Across the Lifespan; College and Occupational Stress.

UNIT-III

Stress and Work performance: Role of communication in managing stress and work performance: Emotional regulation and coping; Emotional intelligence and conflict management: Emotional Basis and Stress; Stress and Conflict in Relationships. Stress intervention – interpersonal, Management Standards and Management Competencies.

UNIT-IV

Strategies of Stress Management: Prevention of stress Challenging Stressful Thinking; Problem Solving; Emotional and cognitive coping styles: Strategies of Synthesis and Prevention: Resilience and Stress; Optimal functioning; Making changes last; Small changes and large rewards.

UNIT-V

Preparing for the Future: Care of the Self: Nutrition and Other Lifestyle Issues: Stress reduction practices: Time management; Exercise; Relaxation techniques; yoga; meditation.

COURSE OUTCOMES:

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

1. To understand the cognitive variables of stress and Learn Managing Work-Life Balance
2. Preparing for better future by reducing the stress.
3. To understand the nature and consequences of stress
4. To understand the impact of stress on work.
5. To recognize the stressors, Adaptive and Maladaptive behavior

REFERENCES:

1. Baron .L & Feist.J (2000) Health Psychology 4th edition, USA Brooks/Cole
2. Barlow, Rapee, and Perini(2014), 10 Steps to Mastering Stress: A Lifestyle Approach, USA
3. Clayton,M, (2011).Brilliant stressmanagement How to manage stress in any situation's 1st edition, Greart Britain Pearson Education
4. Cooper,C,& Palmer,S, (2000)Conquer Your Stress, London: Institute of personal development Universities Press
5. Dutta, P,K, (2010) Stress management Himalaya, Himalaya Publishing House
6. Lee, K. (2014). Reset: Make the Most of Your Stress: Your 24-7 Plan for Well-being. Universe Publishing.

PE27C UNIVERSAL HUMAN VALUES

M.Tech II Semester

Common to Industrial Engineering & Production Engineering

Instruction Hours/ Week: (L-T-P-C): 3-0-0-3

COURSE CONTENT:

UNIT-I

Introduction to Value Education : Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education) Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Happiness and Prosperity – Current Scenario, Method to Fulfil the Basic Human Aspirations.

UNIT-II

Harmony in the Human Being : Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health.

UNIT-III

Harmony in the Family and Society: Harmony in the Family – the Basic Unit of Human Interaction, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Other Feelings, Justice in Human-to-Human Relationship, Understanding Harmony in the Society, Vision for the Universal Human Order.

UNIT-IV

Harmony in the Nature/Existence : Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfillment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence.

UNIT-V

Implications of the Holistic Understanding – a Look at Professional Ethics : Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession.

COURSE OUTCOMES:

1. To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS.'
2. To ensure sustained happiness and prosperity which are the core aspirations of all human beings
3. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence.
4. To develop a holistic perspective of Universal Human Values and movement towards value-based living in a natural way.
5. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.

REFERENCES:

1. Jeevan Vidya: EkParichaya, A Nagaraj, JeevanVidyaPrakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj – Pandit Sunderlal.

IE28M MINI PROJECT WITH SEMINAR

Instruction Hours/ Week: (L-T-P-C): 1-0-2-2

COURSE CONTENT:

The students are required conduct experimental work/mathematical modelling/simulation on software packages etc. And collect relevant for analysis, and deduct the conclusions from results. Finally, the student should prepare the report and give seminar on project.

COURSE OUTCOMES:

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

1. Apply emerging technology in processes and systems
2. Analyze the results
3. Deduct conclusions from results
4. Prepare report/document
5. Present effectively.

Semester III & IV

PE33ED and PE41D Dissertation WorkPhase–

I, Phase–II and Viva-Voce

GUIDELINES FOR DISSERATION PHASE-I AND DISSERATION PHASE-II:

1. The dissertation is a yearlong activity; to be carried out and evaluated in two phases i.e. Phase–I in sem-3andPhase–II in sem-4.

2. The dissertation may be carried out in department laboratories/ industry.

3. After multiple interactions with guide and based on comprehensive literature survey, the student shall identify the domain and define dissertation objectives.

4. Phase–I evaluation: A committee comprising of guides o respective specialization shall assess the progress/ performance of the student based on report, presentation and Q&A. In case of unsatisfactory performance, committee may recommend repeating the Phase-I work.

5. During phase – II, student is required to continue Phase-1 as per the schedule and thesis (combined phase-1&2) should be submitted at end of sem-4. Accomplished results/contributions/innovations should be published in reputed journals/ conferences/Patents.

6. Phase – II evaluation: Guide, committee with external examiner shall assess the progress/performance of the student based on report, presentation and Q&A. In case of unsatisfactory performance, committee may recommend for extension or repeating the work.

COURSE OUTCOMES:

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

1. Synthesize knowledge and skills previously gained and applied to anin-depth study and execution of new technical problem.
2. Select different methodologies to carry out the selected project work.
3. Deduct conclusions from results
4. Prepare report/document
5. Present effectively