Savitribai Phule Pune University

Faculty of Engineering

Board of Production and Industrial Engineering

Master of Engineering
Syllabus 2017
For

ME (Production) Manufacturing and Automation Engineering

M. E. – Production Engineering [Manufacturing and Automation] 2017

Semester I

Course Code	Course	Teaching Scheme (Hrs/week)			Examination Scheme						Credit	
					Paper		TW	OR	PR	Total	TH/TW/TUT	PR/OR
		Theory	Practical	Tutorial	In-Sem	End-Sem						
511101#	Mathematics & Statistics	4	-	-	50	50	-	-	-	100	4	-
511102#	Research methodology	4	-	-	50	50	-	-	-	100	4	-
511103	Advanced Manufacturing Processes	4	-	-	50	50	-	-	-	100	4	-
511104	Industrial Automation	4	-	-	50	50	-	-	-	100	4	-
511105	Elective I	5	-	-	50	50	-	-	-	100	5	
511106	Lab Practice I	-	4	-	-	-	50	50	-	100	--	4
Total		**21**	**4**	**-**	**250**	**250**	**50**	**50**		**600**	**21**	**4**

M. E. – Production Engineering [Manufacturing and Automation] 2017

Semester II

Course Code	Course	Teaching Scheme (Hrs/week)			Examination Scheme						Credit	
					Paper		TW	OR	PR	Total	TH/TW/TUT	PR/OR
		Theory	Practical	Tutorial	In-Sem	End-Sem						
511305#	Computer Integrated Manufacturing	4	-	-	50	50	-	-	-	100	4	-
511306#	AI & Robotics	4	-	-	50	50	-	-	-	100	4	-
511109	Additive Manufacturing	4	-	-	50	50	-	-	-	100	4	-
511110	Elective II	5	-	-	50	50	-	-	-	100	4	-
511111	Lab Practice II		4	-	-	-	50	50	-	100	-	5
511112	Seminar I		4	-	-	-	50	50	-	100	-	4
Total		**17**	**08**	**-**	**200**	**200**	**100**	**100**		**600**	**16**	**09**

M. E. – Production Engineering [Manufacturing and Automation] 2017

Semester III

Course Code	Course	Teaching Scheme (Hrs/week)			Examination Scheme						Credit	
					Paper		TW	OR	PR	Total	TH/TW/TUT	PR/OR
		Theory	Practical	Tutorial	In-Sem	End-Sem						
611101#	Computational Intelligence in Tool Design	4	-	-	50	50	-	-	-	100	4	-
611102	Mechatronics	4	-	-	50	50	-	-	-	100	4	-
611103	Elective III	5	-	-	50	50	-	-	-	100	5	-
611104	Seminar II	-	4	-	-	-	50	50	-	100	-	4
611105	Project Work Stage I	-	8	-	-	-	50	50	-	100	-	8
.Total		**13**	**12**	**-**	**150**	**150**	**100**	**100**	**-**	**500**	**13**	**12**

M. E. – Production Engineering [Manufacturing and Automation] 2017

Semester IV

Course Code	Course	Teaching Scheme (Hrs/week)			Examination Scheme						Credit	
					Paper		TW	OR	PR	Total	TH/TW/TUT	PR/OR
		Theory	Practical	Tutorial	In-Sem	End-Sem						
611106	Seminar III	-	5	-	-	-	50	50	-	100		5
611107	Project Work Stage II	-	20	-	-	-	150	50	-	200		20
.Total			**25**	**-**	**-**	**-**	**200**	**100**	**-**	**300**		**25**

Elective I

- Advanced Machine Tool Design
- Quality & reliability Engineering
- Intelligent Manufacturing Systems
- Manufacturing Management

Elective II

- Manufacturing system design
- Product Life Cycle Management
- Plastics Processing
- Supply Chain Management

Elective III (Open Elective)

- Tribology & Surface Engineering
- Energy Management
- Human factors in design & manufacturing
- Engineering Economics & cost

511101: Mathematics and Statistics

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 4 hours / week	Theory: 04	In-Sem: 50 Marks End-Sem : 50 Marks

Course Objectives:

- Introduce complex variables, various theorems and applications
- Introduce Calculus of variations and different problems on physical situations and their solutions by various methods
- Define and give concrete ideas about difference equations and their applications
- Introduce series solutions for special functions, Bessel's and Legendre polynomials Fourier Bessel expansion and its application to boundary value problems.
- Introduce new concept of Mathematical modeling, number generation and simulations like Monte Carlo-Simulation.
- Deal with Statistics and probability, Stochastic process's , Markov Process.

Course Outcomes

- Analyze the given complex number, solve various problems on complex variables, apply various theorems of complex variables, apply series solution method.
- Interpret variational notation, Euler's first order condition, assimilate various principals like Lagrange's multipliers ,Hamilton Principle ,various equations like Strum-Lioville's equation, study variational problems Galerkins's and Raleigh –Ritz method.
- Distinguish differential and difference equations and their solutions, finite difference solutions of types elliptic parabolic and hyperbolic, apply Laplace , Poisson and Cauchy's equations practically in various fields.
- Express differential equation and its solution in Series, & apply the fundamentals concepts of Bessel's functions and Legendre's polynomial , generating functions etc. Apply these for solving boundary value problems.
- Fit models to data, create simulations, to model probabilistically, generate random number, bootstrapping, Monte- Carlo simulation, and improve efficiency technique. Simulate output analysis.
- Analyze random variables, distribution theory, various tests. Demonstrate Stochastic process's , Markov Process. Test reliability.

Unit I

Complex Variables

Analytical functions, conformal mapping, bilinear transformations, complex integration, Cauchy's integral theorem and formula, Taylor's and Laurent's series, Cauchy's residue theorem, Applications to Dirichlet's and Neumann's problems.

Unit II

Calculus Of Variations

Introduction, Variational notation, Euler's first order condition with extension to several independent variables, constraints and Lagrange's multipliers, Hamilton's principle, Lagrange's equation in generalized co-ordinates, strum-Liouville's equation with orthogonal character of the solution for different values of physical problems involving differential equations expressed as Variational problems Galerkin's and Raleigh- Ritz method.

Unit III

Numerical Solution to Partial Differential Equations

Difference equations and their types, Solutions of difference equations, finite difference equivalence of solutions of Elliptic Parabolic and hyperbolic equations. Applications to Laplace, Poisson and Cauchy's equations.

Unit IV

Special Functions

Differential Equations and its solutions in series, Bessel's and Legendre's differential equations and their series solutions, properties of Bessel's functions and Legendre's polynomials, generating functions, recurrence relations, Fourier Bessel expansion of function and its applications to boundary value problems.

Unit V

Mathematical Modelling

Proportionality Models, fitting models to data, creating simulations, dimensional analysis, probabilistic modeling, optimization (discrete and continuous models), multivariate random number generation, bootstrapping, Monte Carlo simulation, efficiency improvement techniques, simulation output analysis.

Unit VI

Statistics and Probability

Random variables, various distributions, sampling theory, Chi- square test, t-tests, elementary Stochastic process's, Markov-chain, Markov process, reliability testing. Control chart.

References

1. Erwin Kreyzig, Advanced Engineering Mathematics, Jhon Wiely & Sons. ISBN: 0470458364
2. Spiegel, Complex Variables, Schaum's Series. ISBN: 0070602301
3.B.S.Grewal, Numerical Methods in Engineering and Science, Khanna Publishers, New Delhi.
4. Mark Meerschaert, Mathematical Modeling, Elsevier. ISBN: 0123708575
5. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, New Delhi. ISBN: 8174091955

511102: Research Methodology

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 4 hours / week	Theory: 04	In-Sem: 50 Marks
		End-Sem : 50 Marks

Course Objectives:

To provide students in depth knowledge about various soft and hard computing tools and techniques so as to enable them:

- To investigate complex problems in manufacturing
- To investigate laws of nature
- To optimize process parameters
- To provide cost effective solutions

Course outcome:

After learning the course, students will be able to:

- Select and apply appropriate methodology to their research problems.
- Organize, conduct and present the research work in most effective manner

Unit I
Introduction

Nature and objectives of research. Methods of Research: historical, descriptive and experimental, research process, research approaches, criteria for good research, problems faced by researchers

Unit II
Research Design

Meaning of research design, need of research design, features of good design, different research designs, basic principles of experimental designs, design of experiments.

Unit III
Data Collection

Types of data, methods and techniques of data collection, primary and secondary data, meta analysis, historical methods, content analysis, devices used in data collection, pilot study and pretest of tools, choice of data collection methods.

Unit IV
Processing and Analysis of Data

Use of statistics for data analysis, measures of central tendency, dispersion, skewness and relationship. Sampling distributions, sampling theory, determination of sample size, chi-square test, analysis of variance, multiple regression analysis, neural networks.

Unit V
Decision Making Techniques

Multi-attribute decision making techniques: Analytical Hierarchy Process (AHP), TOPSIS, Data Envelope Analysis (DEA), graph theory and matrix approach.
Multi-objective decision making techniques: Simulated annealing, Genetic algorithms.

Unit VI
Interpretation and Report Writing

Techniques of interpretation, precautions in interpretation, significance of report writing, different steps in report

writing, layout of research report, mechanics of writing research report.

References

1. C.R Kothari “Research Methodology” Wishwa Prakashan, ISBN: 8173280363
2. P.G Triphati “Research Methodology” Sultan Chand & Sons, New Delhi.
3. J. W Barnes, “Statistical Analysis for Engineers and Scientists” McGraw Hill, New York. ISBN: 0078396085
4. Ranjit Kumar “Research Methodology” Pearson Education, ISBN: 9788131704967
4. R. V. Rao “Decision making in the manufacturing environment using graph theory and fuzzy multiple attribute decision making” Springer-Verlag, London. ISBN: 1846288193
5. Rao S. S., “Optimization”, Wiley Eastern, New Delhi, 1995. ISBN: 0471550345
6. Montgomery D.C., “Design and analysis of experiments”, John Wiley & Sons, ISBN: 0470128666.

511103: Advanced Manufacturing Processes

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 4 hours / week	Theory: 04	In-Sem: 50 Marks
		End-Sem : 50 Marks

Course Objectives:

- To inculcate specialized knowledge and skill in advanced manufacturing processes using the principles and methods of engineering analysis and design.
- To cultivate the ability to develop and implement new improved manufacturing processes resulting in creation and distribution of value in engineering applications.
- To impart knowledge about the significance of controlling process parameters for the optimal performance for newly developed engineering materials used in industries and research organizations.

Course Outcomes:

The students will be able to:

- Model the various modern manufacturing processes
- Analyze the processes and evaluate the role of each process parameter during machining of various advanced materials.
- Solve the various problems for the given profiles to be imparted on the work specimens.
- Select the best process out of the available various advanced manufacturing processes for the given job assignment.
- Understand requirements to achieve maximum material removal rate and best quality of machined surface while machining various industrial engineering materials.

Unit I

Principles of Casting

Principles of Casting – metals and their alloys, Mechanism of melting and solidification, grain growth and structure, shrinkage defects. Mold filling – fluidity and turbulence, filling under gravity and pressure; filling defects; gating design, Injection Molding, Simulation of Mold filling and Solidification.

Unit II

Fundamentals of Fusion Welding

Fundamentals of fusion welding processes – analysis of heat source, types of metal transfer, weld pool characteristics, solidification mechanisms in fusion zone, heat affected zone characteristics, types of weld joint, distortion and residual stresses, weld defects, destructive and non-destructive testing of welds.

Unit III

Non Conventional Machining Processes

Introduction and need of Non-conventional machining processes- Principle, Theory of material removal, process parameters, advantages, limitations and applications of Ultrasonic machining, Electro discharge machining, Laser beam machining and Electro chemical machining.

Special processes: Micro and Nano machining, molecular dynamic analysis, dry-electro discharge machining, electro discharge chemical machining, vacuum coating, Ballistic machining, unit head machining, hot machining.

Unit IV

Advances in Material Forming

Macroscopic plasticity and yield criteria, plastic instability, strain rate and temperature, slab analysis, upper bound analysis, slip line field theory, plastic anisotropy, and numerical analysis of material forming processes.

Unit V

Sheet Metal Forming

Formability, bending, cupping, redrawing, ironing, complex stamping, metal spinning, stretch forming, fine blanking, high speed blanking.

Unit VI

Non Conventional Forming Processes

High energy rate forming, electromagnetic forming, explosive forming, high speed hot forging, high velocity extrusion, high speed forming machines, peen forming, study of various process parameters.

References

1. B.H. Amsteal, Philip F. Ostwald and Myron L. Begeman, “Manufacturing Processes", Wiley; 8th edition, ISBN-10: 0471842362, ISBN-13: 978-0471842361.
2. G.F. Benidict "Advanced Manufacturing processes", Marcel Dekker Publisher, Inc. New York (ISBN 0-8247-7352-7).
3. E. Paul DeGarmo, J. T. Black and Ronald A. Kohser, “Materials and Processes in Manufacturing”, Wiley; 9th edition, ISBN 9780471656531.
4. P. N. Rao, “Manufacturing Technology” Vol. 1- Foundry Forming & Welding; Tata Mc Graw Hill Publishing Co Ltd. ISBN: 9780070087989.
5. American Soc. For Metals, Metals Handbook, 10th Edition, Vol. 15, on Metal Forming, ASM, Metals Park, Ohio, 1989.
6. Raj, Shankar, Bhandari, “Welding Technology for Engineers”, Narosa Publication House Pvt. Limited.
7. Prashant P. Date “Introduction to Manufacturing Technologies”, Jaico Publishing House (2010) ISBN: 9788179929971

511104: Industrial Automation

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 4 hours / week	Theory: 04	In-Sem: 50 Marks
		End-Sem : 50 Marks

Course objectives:

Demonstrate automation strategies using hydraulic, pneumatics, and control systems in an integrated manner and their effective manufacturing application to material handling, robotics and machine tools.

Course outcome:

After learning the course, students will be able to:

1. Analyse, evaluate, Compare, and Select most appropriate automation strategy to given application.
2. Select the components from standards for chosen automation system
3. Provide cost effective design for automation systems in manufacturing application

Unit I

Automation Using Hydraulic Systems

Hydraulic fluid, fluid mechanics, design aspects of various elements of hydraulic systems such as pumps, valves, filters, reservoirs, accumulators, actuators, intensifiers etc. and their selection. Practical case studies on hydraulic circuit design and performance analysis. Servo valves, hydraulic servo actuators, electro hydraulic servo-valves, proportional valves and their applications, Modeling and Simulation of Electro-hydraulic Servo systems.

Unit II

Automation Using Pneumatic Systems

Pneumatic fundamentals - control elements, position and pressure sensing -logic circuits - switching circuits - fringe conditions modules and these integration - sequential circuits - cascade methods - mapping methods – step counter method - compound circuit design - combination circuit design. Pneumatic equipments - selection of components – design calculations -application - fault finding – hydro pneumatic circuits –

Unit III

Control Technologies in Automation

Industrial Control Systems, process industries verses discrete-manufacturing industries, continuous versus discrete Control. Computer based control process and its forms. Open and closed loop control system. Control system components. Introduction to sensor technology, various sensors, transducers, signal processing. Programming of microprocessors using 8085 instructions. Programmable logic controllers.

Unit IV

Automated Work Piece Handling

Working principles and techniques, job orienting and feeding devices. Transfer mechanisms, automated feed cut of components, performance analysis. Types of automated handling systems including AGV and its various guiding technologies, applications.

Unit V

Introduction to Robot Technology

Robot classification, robot elements, Robot co-ordinate systems, Position, path and speed control systems, robot programming for foundry, presswork, and machining. Collisions free motion planning.

Unit VI

Modeling and Simulation for Manufacturing Plant Automation

Introduction/ need for system Modeling, Building Mathematical Model of a manufacturing plant, Modern Tools- Use of Fuzzy decision making and Artificial Neural Networks in manufacturing automation, AI in manufacturing systems

References

1.Mikell P. Grover "Automation, Production Systems and Computer-Integrated Manufacturing" Pearson Education, New Delhi. ISBN: 0132393212

2.Antony Esposito, "Fluid power with Applications" Pearson Education India. ISBN:8177585800

3. Andrew Parr, " Hydraulic and Pneumatics ", Butterworth-Heinemann. ISBN:0750644192

4. Bolton. W. "Pneumatic and Hydraulic Systems" Elsevier Science & Technology Books. ISBN:0750638362

5. N. Viswanandham, Y. Narhari "Performance Modeling of Automated Manufacturing Systems" Prentice-Hall. ISBN: 0136588247

6. S. R. Mujumdar, "Pneumatic system", Tata McGraw Hill. ISBN: 0074602314

7. W Bolton., "Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering" Prentice-Hall. ISBN: 0131216333

8. C D Johnson, "Process Control Instrumentation Technology", Prentice Hall of India, New Delhi. ISBN: 8120309871.

511105A: Advanced Machine Tool Design- (Elective-I)

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 5 hours / week	Theory: 05	In-Sem: 50 Marks
		End-Sem : 50 Marks

Course Objectives:

- To understand different types of machine tools.
- To analyze the source of vibration in machine structure.
- To apply ergonomics in machine control.

Course Outcomes:

- Identify functions of various parts of the machine tool.
- Design parts of Machine tool considering functions of each part.
- Testing machine tool form acceptance point of view.

Unit I

Introduction

Introduction to Metal Cutting Machine tools, Kinematics, Basic Principles of Machine tool design, estimation of drive power. Design requirements of machine tools. Design approach for machine tools. Identification and quantification of objectives and constraints in machine tool design.

Unit II

Design of Structural Components

Design of Machine tool spindle and bearings, Design of power Screws – Static deformation of various machine tool structures - thin walled box structures with open and compliant cross sections - correction coefficients - design of beds, columns, tables and supports. Dynamics of cutting forces - tool chatter - design of sideways.

Unit III

Design of Drives

Design considerations of electrical, mechanical and Hydraulic drives in machine tool, stepped and step-less arrangements and systems. Design of control mechanisms - selection of standard components – Dynamic measurement of forces and vibrations in machine tools - Stability against chatter - use of vibration dampers.

Unit IV

Design of CNC Machine Tool

CNC machine - block diagram showing memory, CPO, I/O, post processor, etc. Machining center, Auto tool changers, and uses of composites in machine tool. DNC and Local Area Network, machines with Adaptive Control. Design of slides with reinforced PTEE, Ball screw all design, methods of calculation of load, Reliability based design. Static and dynamic rigidity and stability analysis.

Unit V

Testing Of Machine Tools

Vibration study of machine tool structures – micro-displacement and error analysis of machine tools with reference to transmission system and positional displacement (stick slip). Acceptance tests and standardization of machine tools- machine tools reconditioning.

Unit VI

Ergonomics Applied To Machine Tool

Concepts of aesthetics and ergonomics applied to machine tools, Latest trends in Machine Tool Design, Introduction to CAD and Finite Element Method used in machine tool design.

References:

1. Mehta N. K.,"Machine Tool design and Numerical Control",Tata McGraw Hill, 1989ISBN: 1259004570
3. Acherkan N., "Machine Tool Design",Vol.3 and 4,MIR Publishers, Moscow ISBN: 0898750474
4. Sen.G. and Bhattacharya, A., "Principles of Machine Tools",Vol.2,NCB.Calcutta, 1973 ISBN: 81-7381-155-5
5. Basu S. K. and Pal D. K., “Design of Machine Tools”, Oxford University Press, 2008 ISBN: 8120417216
6. Rao S. S., “The Finite Element Method in Engineering”, Elsevier Science and Technology Books, 2004, ISBN: 0750678283.

511105 B: Quality and Reliability Engineering (Elective-I)

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 5 hours / week	Theory: 05	In-Sem: 50 Marks
		End-Sem : 50 Marks

Course Objectives

This subject provides students with

- Principles of reliability, failure rate and its relation to reliability, probability distribution of the time to failure, exponential and weibull distributions, reliability of systems, series and parallel systems, stand by redundancy, systems mean time to failure, mean residual life, reliability in design.
- Failure mode effect analysis, failure tree analysis, reliability testing and analysis, and warranty problems.
- the ability to use statistical tools to characterize the reliability of an item; the working knowledge to determine the reliability of a system and suggest approaches to enhancing system reliability;

Course Outcomes:

Upon completion of the subject, students will be able to

- analyze the interference between strength and stress or life data for estimating reliability;
- apply the appropriate methodologies and tools for enhancing the inherent and actual reliability of components and systems, taking into consideration cost aspects;
- Specify life test plans for reliability validation.
- Use knowledge of the techniques of reliability engineering
- apply learned concepts to improving the maintenance, the maintainability, hazard risk and the safety of a plant
- Develop warranty plans for different products
- Be able to carry out a failure mode effect and criticality analysis.
- Analysis of different failures of a component/equipment

Unit I

Concepts of Quality Engineering

Taguchi's Approach to Quality, On-line and Off-line Quality Control, Difference from Classical Approach, Quality Loss Function,System Design, Parameter Design, Tolerance Design, Causes of Variation,Classification of Parameters, Parameter Design Strategy

Unit II

Steps in Robust Design

Quality Characteristics and Objective Functions, Control Factors and their Levels, Noise Factors and Testing Conditions, Planning and Conducting the Experiment

Unit III

Response Surface Methodology

First- order and Sec ond-order Models, Crossed Array Experiments, Signal-to-Noise Ratios

Unit IV

Reliability Engineering

The Reliability Function, Failure Rate, Hazard Rate, Bath-tub Curve, Relationship between Various Reliability Characteristics hazard, Component Reliability, Mean-time-to-failure, Time-dependent Hazard Models Constant-Linear-hazard, Nonlinear-hazard and Gamma Model

Unit V
System Reliability
Two-state Modeling, Series Models, Parallel Models, Series-parallel and Parallel-series Models, k-out-of-m Models, Standby Models, Non-series-parallel Models, Fault-tree Approach to System Modeling

Unit VI
Maintained Systems
Classification of Maintenance Activities: Breakdown, Preventive and Predictive Maintenance, Condition Monitoring, Maintainability and Availability, Reliability-centered Maintenance

References:

1. Phadke, M (1989). Quality Engineering using Robust Design, Prentice Hall.
2. Ross, P (1996). Taguchi Techniques for Quality Engineering, 2nd edition, McGrawHill.
3. Balgurusamy E (2003). Reliability Engineering, Tata McGraw Hill.
4. Birolini A (2004). Reliability Engineering: Theory and Practice, 4th edition, Springer.
5. Crowder M, Kimber A, Smith R and Sweeting T (1991). Statistical Analysis of Reliability Data, Chapman and Hall.
6. Kumamoto H and Henley E (1996). Probabilistic Risk Assessment and Management for Engineers and Scientists, IEEE Press.

511105 C: Intelligent Manufacturing Systems (Elective I)

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 5 hours / week	Theory: 05	In-Sem: 50 Marks
		End-Sem : 50 Marks

Objectives:

To provide students in depth knowledge through practical case studies related to artificial intelligence (AI) and decision making techniques to solve the real problems in automated manufacturing system. The objective of this course is to learn the statistics and optimization methodologies in intelligent manufacturing systems. The students will know how to apply

Outcome:

Student will be able to apply the intelligent systems such as Evolutionary computation, fuzzy logic, Bayesian network, Hidden Markov model, Kalman filter, Decision theory and Utility theory, statistical learning methods, support vector machines, neural networks, expert systems etc in various applications in manufacturing such as:

- Process planning
- Process optimization
- Cellular manufacturing
- Route optimization of AS/RS
- Robot path palling etc.

Unit I:

Introduction to artificial intelligent techniques [7]

Goals of AI in manufacturing, tools for AI such as Search algorithm, Mathematical optimization, Evolutionary computation, fuzzy logic, Probabilistic methods for uncertain reasoning such as Bayesian network, Hidden Markov model, Kalman filter, Decision theory and Utility theory, statistical learning methods, support vector machines, neural networks, expert systems.

Unit II:

Industrial planning and decision making using intelligent systems [7]

Production planning using fuzzy cognitive maps, computer aided process planning, Methods for inventory space allocation and storage processes analysis, Optimization of production costs and methods finding of the best process plan, Methods for production equipment selection and layout, Heuristic scheduling of multiple resources, Fuzzy multiple attribute decision making methods.

Unit III:

Intelligent techniques for manufacturing process optimization [7]

Application of neural networks and fuzzy sets to machining and metal forming, Artificial neural network modeling of surface quality characteristics in machining processes, parametric optimization of machining processes using evolutionary optimization methods**.**

Unit IV:

Knowledge Based Group Technology [7]

Group Technology: Models and Algorithms – Visual method, Coding method, Cluster analysis method Knowledge based group technology – Group technology in automated manufacturing system, Structure of

knowledge based system for group technology (KBSGT) –database, knowledge base, Clustering algorithms

Unit V:
Intelligent robotic systems [7]
Applications of intelligent systems for mobile Robot Motion Planning, Path Planning Robot Control in Dynamic Environments, Task Based Hybrid Closure Grasping Optimization for Autonomous Robot Hand. Accurate Motion Control of Fast Mobile Robots, obstacle avoidance.

Unit VI:
Use of intelligent techniques in flexible manufacturing systems (FMS)
Applications of various intelligent systems for FMS functional segmentation schemes including control, real time scheduling, tool management, process planning, route optimization for AS/RS systems.

References:

1. Andrew Kussiak, "Intelligent Manufacturing Systems", Prentice Hall , 1990
2. Badiru A.B., "Expert Systems Applications in Engineering and Manufacturing", Prentice-Hall, New Jersey, 1992.
3. Liu, Dikai, Wang, Lingfeng, Tan, Kay Chen (Eds.) Design and Control of Intelligent Robotic Systems, Springer-Verlag, London. ISBN 978-3-540-89932-7
4. Rao R. V. "Advanced Modeling and Optimization of Manufacturing Processes**",** Springer-verlag, London. ISBN 978-0-85729-014-4
5. N. Singh and Divakar Rajamani, Cellular Manufacturing Systems- Design, planning and control, Springer US

511105D: Manufacturing Management (Elective I)

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 5 hours / week	Theory: 05	In-Sem: 50 Marks
		End-Sem : 50 Marks

Course objectives:

- To study various functions of production planning and control
- To study world class manufacturing techniques.

Course outcomes:

- Student will able to understand various manufacturing strategies
- Student will able to understand various tools of quality management
- Student will able to understand group dynamics

Unit I

Scope of Manufacturing Management

History and development of Manufacturing Management - Contribution of various pioneers, overview of manufacturing systems, Manufacturing Management - Nature, Scope, Importance and Functions, Its relationship with other functions

Unit II

Production Planning & Control

Functions of Production Planning & Control (PPC), Scheduling – Graphical and analytical techniques, Master Production Schedule, line balancing, Documentation - Production Work Order. Introduction to PERT/CPM, Network Crashing

Unit III

Advanced Topics in Production Management

Concept of world-class manufacturing, Total quality management, manufacturing challenges of information age, JIT, lean and agile manufacturing, reconfigurable manufacturing, green production, computerized production management system, simulation of manufacturing systems

Unit IV

Quality Management

Foundations of quality management, Fundamentals of statistical studies, Tools and methods of analytic studies, stabilizing and improving a process with control charts, Process capability and improvement studies, inspection policy, Fork Model for Quality Management, Current thinking about statistical practice

Unit V

Manufacturing Strategy

Need for manufacturing strategy (MS) and concept of MS, Structured strategy formulation,

Focus of MS decisions relating to capability, flexibility, product variety, inventory, supplier relationships, manufacturable design. Role of Quality in the framework of MS-TQM, SPC, 6-sigma. Interface of marketing and manufacturing, financial aspects,Performance measurement in MS, Ingredients for a world-class manufacturing strategy, Contemporary cases from Indian manufacturing

Unit VI

Group Dynamics and Team Working

Theories of Group Formation - Formal and Informal Groups, their interaction – Importance of teams - Formation of teams - Team Work. Conflict Management - Traditional vis-à-vis Modern view of conflict - Stress management, Conflict Process - Strategies for encouraging constructive conflict - Strategies for resolving destructive conflict.

References

1. Fred Luthans, Organizational Behaviour, McGraw-Hill. ISBN: 0073404950
2. P. K. Saxena, "Principles of Management: A modern approach" Global India Publications. ISBN: 8190794159
3. Krajewski, "Operations Management" Pearson Education India. ISBN: 8131711315
4. Panneerselvam, Production & Operations Management. PHI New Delhi.
5. E. E. Adam, R. J. Ebert "Production & Operations Management" Prentice Hall. ISBN: 013717943X
6. Howard Gitlow, Alan Oppenheim, Rosa Oppenheim and David Levine, "Quality Management" (3rd Edition), Tata McGraw-Hill Publishing Company Ltd.
7. Eli Goldratt, "Critical Chain", North River Press
8. John Nicholas," Competitive Manufacturing Management", McGraw-Hill Publishing Co.
9. V.K. Narayanan, "Managing Technology & Innovation for Competitive Advantage"

511106: Lab Practice I

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 4 hours / week	Theory: 04	Oral: 50 Marks
		TW : 50 Marks

Each student has to prepare a report based on ***any eight*** of the following laboratory work

1. Analysis of regenerative circuit.
2. Study of meter in and meter out circuit
3. Practical case study on evaluation of alternative hydraulic circuit design
4. Study of effect of process parameters for any non-traditional machining process
5. Experimental analysis of any one of the metal forming processes
6. Experimental analysis of casting process.
7. Industrial case study on design of experiment
8. Industrial case study on multi-attribute decision making
9. Numerical solution of a partial differential equation by using different methods
10. Manufacturing application of T test and Chi-square test.

511305: Computer Integrated Manufacturing

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 4 hours / week	Theory: 04	In-Sem: 50 Marks
		End-Sem : 50 Marks

Course objectives-
To use computers in the area of manufacturing to reduce manual processing and linking computers to all the manufacturing machines and increase the productivity, reduce the unnecessary costs. To study about group technology, computer aided process planning, material requirement planning (MRP) Enterprise resource planning (ERP), Computer aided quality control and Flexible manufacturing systems.

Course outcomes
On completion of the course, student will be able to:

- Understand the basic concept of CIM and develop product through CIM.
- Apply various techniques of cellular manufacturing for machine cell formation.
- Learn the different components of Flexible Manufacturing System.
- Understand the principle of networking and design activities in a networked environment.

Unit I
Concept of CIM:
Introduction to CIM, Types of Manufacturing, CIM hardware and software, Elements of CIM, Product development through CIM

Unit II
CIM database
Introduction, Database requirements of CIM, Database, Database management, Database Models, Product Data Management (PDM), Advantage of PDM.

Unit III
Work Cell :
Manufacturing cell, Group Technology, Cellular Manufacturing

Unit IV
Flexible Manufacturing System:
Introduction to FMS, Manufacturing integration model, flexible manufacturing strategy, Components of Flexible Manufacturing-Pallets and fixtures, machining centers, inspection equipment, material handling stations, storage system, In-process storage, manually operated stations, allied operation centers, FMS system design

Unit V
Robots in CIM :
Integration of the industrial robot into CIM system, product design of automatic manufacture of robots, computer aided inspection using robots.

Unit VI

Networking in CIM:

Principles of networking, Network Techniques, Local area network (LAN), networking standards, Design Activities in a networked environment, networking in a manufacturing company, hardware elements of networking, Collaboration Engineering.

References Book:

1. Paul G. Ranky, The design and operation of FMS, I.F.S. Publi 1983 Harrington J, C.I.M. m Krieger 1979
2. Richard Shover, An analysis of CAD/ CAM Application with introduction to C.I.M., Prentice hall Inc. Engelwood Cliffs NJ
3. David Bedworth et.al Computer integrated design and manufacturing McGraw hill 1991
4. Scolz B. Reiter C.I.M interfaces Chapman & Hall 1992 David L. Goetsch, fundamental of CIM technology, Delmer Publication 1988
5. Nanua Singh**,** Systems Approach to Computer-Integrated Design and Manufacturing

511306: Artificial Intelligence and Robotics

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 4 hours / week	Theory: 04	In-Sem: 50 Marks
		End-Sem : 50 Marks

Objectives:

- To study robot control systems, sensors & end effector,
- To develop the ability to analyze and design the motion for robotic systems
- To develop ability for robot programming
- To impart basic knowledge of artificial intelligent tools, search strategies, knowledge representation and their applications to robotics

Outcomes:

Students will be able to:

- Design evaluate performance of robotic control system
- Able to use robot programming languages for robot programming
- Able to select and use appropriate sensors and end effectors for given robotics application
- Apply artificial intelligent tools, search strategies, knowledge representation to various robotics applications.

Unit I

Introduction

Basic concepts - Robot anatomy - Robot configurations - Basic robot motions –Types of robots-Types of drives - Applications - Material handling - processing -Assembly and Inspection - safety considerations.

Unit II

Transformations and Kinematics

Vector operations - Translational transformations and Rotational transformations – Properties of transformation matrices-Homogeneous transformations and Manipulator – Forward solution - Inverse solution.

Unit III

Controls and End Effectors

Control system concepts - Analysis - control of joints - Adaptive and optimal control – End effectors - Classification - Mechanical - Magnetic -Vacuum - Adhesive - Drive systems - Force analysis and Gripper design.

Unit IV

ROBOT Programming

Methods - Languages -Computer control and Robot Software - VAL system and Language.

Unit V

Sensory Devices

Non optical and optical position sensors - Velocity and Acceleration - Range - Proximity -touch - Slip - Force - Torque - Machine vision - Image components - Representation -Hardware - Picture coding - Object recognition and categorization - Software consideration.

Unit VI

Design of Mechanisms and Manipulators

Classification of closed- and open-loop kinematic systems, Definition of mechanisms and manipulators, Kinematic constraints, Degree of freedom (DOF) and Mobility; DH parameters, Coordinate transformations, Matrix methods; Structural analysis and synthesis of mechanisms; Forward kinematics of robot manipulators with examples; Inverse kinematics; Jacobian and singularity; Alternative design solutions of mechanisms and manipulators.

References:

1. King Sun Fu, Gonzalez R.C., and Lee C.S.G., "Robotics: control, sensing, vision and intelligence", McGraw-Hill Book Co.
2. Klafter R.D., Chmielewski T.A. and Negin M., " Robot Engineering An Integrated approach", Prentice Hall of India, New Delhi, 1994.
3. Deb S.R., "Robotics Technology and Flexible Automation ", Tata McGraw-Hill Publishing Co., Ltd., 1994.
4. Craig J.J., "Introduction to Robotics Mechanics and Control ", Addison-Wesley.
5. Groover M.P., "Industrial robotics Technology, programming and applications ", McGraw-Hill Book Co., 1995.
6. Mittal and Nagrath, "Robotics & Control", Tata McGraw-Hill.
7. Ashitava Ghoshal, "Robotics Fundamental Concepts & Analysis", Oxford University Press.

511109: Additive Manufacturing

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 4 hours / week	Theory: 04	In-Sem: 50 Marks
		End-Sem : 50 Marks

Course Objectives:

- To know the principle methods, areas of usage, possibilities and limitations as well as environmental effects of the Additive Manufacturing technologies
- To be familiar with the characteristics of the different materials those are used in Additive Manufacturing.

Course Outcomes:

Upon completion of this course, the students can able to compare different method and discuss the effects of the Additive Manufacturing technologies and analyse the characteristics of the different materials in Additive Manufacturing

Unit I

Introduction

Overview – History – Need-Classification -Additive Manufacturing Technology in product development-Materials for Additive Manufacturing Technology – Tooling – Applications.

Unit II

CAD & Reverse Engineering

Basic Concept – Digitization techniques – Model Reconstruction – Data Processing for Additive Manufacturing Technology: CAD model preparation – Part Orientation and support generation – Model Slicing –Tool path Generation – Softwares for Additive Manufacturing Technology: MIMICS, MAGICS.

Unit III

Prototype properties:

Material properties, color, dimensional accuracy, stability, surface finish, machinability, environmental resistance, operational properties

Unit IV

Liquid Based and Solid Based Additive Manufacturing Systems

Classification – Liquid based system – Stereolithography Apparatus (SLA)- Principle, process, advantages and applications – Solid based system –Fused Deposition Modeling – Principle, process, advantages and applications, Laminated Object Manufacturing

Unit V

Powder Based Additive Manufacturing Systems

Selective Laser Sintering – Principles of SLS process – Process, advantages and applications, Three Dimensional Printing – Principle, process, advantages and applications- Laser Engineered Net Shaping (LENS), Electron Beam Melting

.

Unit VI

Medical and Bio-Additive Manufacturing

Customized implants and prosthesis: Design and production. Bio-Additive Manufacturing- Computer Aided Tissue Engineering (CATE) – Case studies

Textbooks

1. Chua C.K., Leong K.F., and Lim C.S., "Rapid prototyping: Principles and applications", Third Edition, World Scientific Publishers, 2010.
2. Gebhardt A., "Rapid prototyping", Hanser Gardener Publications, 2003.

References:

1. Liou L.W. and Liou F.W., "Rapid Prototyping and Engineering applications : A tool box for prototype development", CRC Press, 2007.
2. Kamrani A.K. and Nasr E.A., "Rapid Prototyping: Theory and practice", Springer, 2006. 3. Hilton P.D. and Jacobs P.F., "Rapid Tooling: Technologies and Industrial Applications", CRC press, 2000
3. Ian Gibson, David Rosen, Brent Stucker, Additive Manufacturing Technologies –Rapid Prototyping to Direct Digital Manufacturing, Springer, 2010

511110A: Manufacturing System Design – (Elective-II)

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 5 hours / week	Theory: 04	In-Sem: 50 Marks
		End-Sem : 50 Marks

Course objectives:

- To understand the concept of manufacturing system along with modes of production.
- To establish understanding the concept of product life cycle and computer aided processes planning.
- To acquire the knowledge of information system and its role in manufacturing.
- To understand the computer simulation and modern approaches in manufacturing system.

Course outcomes:

On successful completion of the course students should be able to:

- Understand the modes of production and the system types in manufacturing environment.
- Implement concept of concurrent engineering, computer aided processes planning, Dynamics programming and network techniques in Industry.
- Develop basic mathematical models along with the understanding of industrial cost estimation practice and the optimization of single stage manufacturing.
- Implement the applications of probability and statics in industry along with the simulation models.
- Apply modern approaches such as lean production, group technology, cellular manufacturing and flexible manufacturing systems in the industry.

Unit I

Fundamentals:

System concept, Hierarchical structure, System design, Decision making procedure, System types in manufacturing environments; Manufacturing Systems: Structural aspects, transformational aspects, procedural aspects, integrated manufacturing systems; Modes of Production- Jobbing / Intermittent /Continuous; Mass Production- Economies of Scale, Optimum production scale, Mass Customization; Multi-Product Small Batch Production-Economies of Scope with Diversification; Logistic Systems-Material flow: conversion / transportation / storage

Unit II

Product / Process Planning and Design

Product Life Cycle, Planning of a new product, Product Design Aspects, Design cost considerations, Concurrent Engineering; Process and Operation Design- Computer Aided Process Planning, Optimum routing analysis using Dynamic Programming and Network Techniques, Criteria for line balancing.

Unit III

Manufacturing Optimization

Criteria for Evaluation, Optimization of single stage manufacturing- Unit production time and cost; Optimization of multistage manufacturing system- Scope, basic mathematical models; Cost Estimating-Classical metal cutting cost analysis, Industrial cost estimation practices, Estimating material, setup and

cycle times.

Unit IV:

Information Systems in Manufacturing

Database structures, hierarchical, network, Relational-concepts, keys, relational operations, query languages; Shop Floor Data Collection Systems-Types of data, on-line and off-line data collection, Automatic data collection systems.

Unit V

Computer Simulation in Manufacturing System Analysis

Characteristics, Simulation Models, applications of probability and statistics; Design and evaluation methodology of manufacturing systems, General design framework, Analysis of situation, Setting objectives, Conceptual modeling, Detailed design, Evaluation and Decision.

Unit VI

Modern approaches in Manufacturing:

Cellular Manufacturing- Group Technology, Application of evolutionary algorithms to cell formation problem, Flexible Manufacturing- Concept, components, architecture; Lean Production- concept, principles, Agile Manufacturing- concept, principles and considerations for achieving agility.

Reference Books:

1. Katsudo Hitomi, (1998), "Manufacturing Systems Engineering", Viva Low Priced Student Edition, ISBN 81-85617-88-0
2. B. Wu, "Manufacturing Systems Design & Analysis: Co ntext and Techniques" (2/e), Chapman & Hall, UK, ISBN 041258140X
3. Mikell P. Groover, (2002), "Automation, Production Systems and Computer Integrated Manufacturing", (2/e), Pearson Education, ISBN 81-7 808-511-9
4. Radhakrishan P., Subramaniyan S. and Raju V., "CAD / CAM / CIM", (3/E), New Age International Publication
5. Luca G. Sartori,(1998), " Manufacturing Information Systems", Addison Wesley Publishing Co.
6. N. Viswanadhan & Y, Narhari, (1998), "Performance Modeling of Automated Manufacturing Systems", Prentice Hall of India
7. Phillip F. Ostwald, Jairo Munez, (2002), " Manufacturing Processes and Systems", John Wiley & Sons (Students' Edition), ISBN 9971-512-34-3
8. Sanjay B. Joshi, Jeffrey S. Smith ,(1994), "Compute r Control of Flexible Manufacturing Systems: Research and Development", Springer, ISBN 0412562006, 9780412562006

511110B: Plastics Processing – (Elective-II)

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 5 hours / week	Theory: 04	In-Sem: 50 Marks
		End-Sem : 50 Marks

Course objectives:

- To study various plastic processes.
- To understand construction features and design of mould

Course outcomes:

- Student will able to design injection moulds.
- Student will able to analyse mould flow.
- Student will able to understand various design considerations required for plastic products.

Unit I

Plastic Materials

Classification of plastic materials, their physical and mechanical properties, selection of plastics for various applications, advantages and limitations of using plastics.

Unit II

Melt Processing Techniques

Polymer processing techniques such as extrusion, compression and transfer moulding, Injection moulding, blow moulding, thermoforming, rotational moulding, calendaring, Bag moulding reaction moulding. Effect of time, temperature and pressure on plastic processing.

Unit III

Constructional Features of Mold

constructional features of core and cavity plates, mold size and strength, cavity material, and fabrication, mold placement, constructional features and layout of runners and gates.

Unit IV

Product Design of Molded Products

Various considerations such as wall thickness, fillets and radii, ribs, under, cuts, drafts, holes, threads, inserts parting lines, etc. surface treatment mould design for avoiding warpage. Standards for tolerances on molded articles.

Unit V

Design of Molds For Plastic Processing

Methodical mold design, determination of economical number of cavities, melt rheology, temperature control of injection molds, calculation of mold opening force and ejection force. Detail design of cooling system, ejection system and gating system. Moulding thermoplastics, thermosets, expandable polysterene, foamed engineering plastics, molds for reaction injection molding.

Unit VI

Computer Applications in Plastic Molding

Use of various software for mold flow analysis, optimum gate location and defect analysis, design of component for balanced flow, optimization of process parameters of plastic molding.

References

1. Edward A. Muccio "Plastic processing technology" ASM International.
2. Fried, "Polymer Science and Technology", Prentice Hall. ISBN: 0136855613
3. Hans Gastrow "Injection Molds: 102 Proven Designs" Hansner. ISBN: 0029494400
4.A. S. Athalye "Plastics Materials Handbook" Multi Tech Publisher Mumbai.

511110C: Supply Chain Management – (Elective-II)

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 5 hours / week	Theory: 04	In-Sem: 50 Marks
		End-Sem : 50 Marks

Course Objectives:

To provide an insight on the fundamentals of supply chain strategy, logistics, sourcing and outsourcing supply chain networks, tools and techniques**.**

Course Outcomes:

- Understand the importance of Supply Chain Management.
- Develop logistical model using appropriate transportation mode.
- Develop and analyse quantitative model for inventory.

Unit I

Introduction

Objectives of Supply Chain Management (SCM), key components of supply chain i.e. sourcing, distribution strategy, customer service strategy; supply chain. Management as Integrated logistics, generic activities, architecture of supply chain, future potential of SCM.

Unit II

Supply Chain Strategies

Evaluation of supply chain strategies, supply chain performance measures, vendor management, JIT, Link to supply chain, evaluation of SCM strategies, customer focus in SCM, inventory and logistics management, vendor management, Just-in- Time (JIT). Supply chain design considerations.

Unit III

Logistic Management

Logistical operation, integration, network design, logistical performance cycle, customer service global logistic, logistical resources, logistic planning.

Unit IV

Warehouse and Transport Management

Concept of strategic storage, warehouse functionality, warehouse operating principles, developing warehouse resources, material handling and packaging in warehouse, transportation management, transport functionality and principles, transport infrastructure, transport economics and pricing, transport decision making.

Unit V

Inventory Management

Cost associated with inventory decisions, selective control, economic order quantity, safety stock and service level, P and Q system, probabilistic models.

Unit VI

Recent Trends in SCM

Tierisation of supplies, Reverse logistics, JIT II, Milk Round System (MRS), bar coding, Hub and Spoke Concept and other latest concepts. IT – enabled supply chain: Electronic data interchange, enterprise resource planning (ERP), Application of IT, Scope of emerging distributed cooperative tele-manufacturing over internet.

References

1. Sunil Chopra, Peter Meindl, D.V. Kalra "Supply Chain Management" Pearson Education Asia, New Delhi. ISBN:9788131789209
2. Christopher "Logistics and Supply Chain Management" Pearson Education Asia, New Delhi. ISBN: 8177588346.
3. Donald B. "Logistic Management - The Integrated Supply Chain process" McGraw Hill, NY. ISBN: 0070068836.
4. D. Chandra bose "Inventory management" PHI Learning Pvt. Ltd., 2006, ISBN: 9788120328532.

511110D: Product Life Cycle Management –(Elective-II)

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 5 hours / week	Theory: 04	In-Sem: 50 Marks
		End-Sem : 50 Marks

Course objectives:

- To study design aspects of product manufactured by different manufacturing process.
- To study the process of transformation of customer requirements into desirable products.

Course outcomes:

- Student will able to design consumer and industrial product using various approaches of product design.
- Student will able to decide the marketing strategies required for different phases of product life cycles.

Unit I

Introduction to PLM

Need for PLM, opportunities and benefits of PLM, different views of PLM, components of PLM, phases of PLM, PLM feasibility study, PLM visioning.

PLM Strategies: Industrial strategies, strategy elements, its identification, selection and implementation, make – to - stock, assemble-to order, make- to order strategy, change management for PLM, Strategies for recovery at end of life, recycling.

Product Data Management (PDM): PDM systems and importance, reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation.

Unit II

Product Design

Engineering design, Industrial design, Generic product design process, Types of products, Product planning, Identify customer needs, product specifications, concept generation, concept selection, concept testing, prototyping, and product cost analysis.

Unit III

Approaches for Product Design

Mass customization, Kano model, Kansei engineering, conjoint analysis, Product architecture, Modular product architecture, product line design, product configuration, and concurrent engineering.

Unit IV

New Product Development

Structuring new product development, need and importance of NPD Voice of customers (VoC), Methods of VoCs, Quality function deployment, building decision support system, Estimating market opportunities for new product, new product financial control, implementing new product development, product family, product mix, market entry decision, Market segmentation, launching and tracking new product program, concept of redesign of product, product development economics.

Unit V

Design for 'X'

Design for manufacturing, Design for assembly, design for reliability, design for serviceability(maintainability),design for environment, design for safety, design for aesthetics, design guidelines for various casting process, injection molding, turning ,milling grinding, sheet metal working processes.

Unit VI

Technology Forecasting

Future mapping, S-curve, invocating rates of technological change, methods of technology forecasting such as relevance trees, morphological methods and mission flow diagram, product design and process selection, product system-level design, product cannibalization and petrification, use of academic research in product design, combining forecast of different technologies, human factors in product design, modeling and simulation in product design.

References

1. K.T. Ulrich and S.D. Eppinger, Product design and development, Tata McGraw - Hill publishing, New Delhi, 2003,ISBN:007-247146-8
2. Dieter and Schmidt , Engineering Design,McGraw – Hill Higher education, ISBN: 978–0–07–283703–2
3. Saaksvuori Antii "Product life cycle Management", Dreamtech Press, ISBN: 8184892705

511111: Lab Practice II

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 4 hours / week	Theory: 05	TW: 50 Marks
		Oral : 50 Marks

Each student has to prepare a report based on following laboratory work.

1. Computer programming 3D transformations
2. Computer programming for synthetic curves/surfaces.
3. CNC part programming and machining
4. Simulation of manufacturing system
5. Finite element analysis for applications in heat transfer/fluid mechanics/plane trusses.Validation using FEM software.
6. Industrial applications for design and analysis of Jigs and fixture/Press Tools/Forging dies/Injection molds
7. Study of temperature distribution due to heat flow in welding
8. Determination of angular distortion in butt welded joints.

511112: Seminar I

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 4 hours / week	Theory: 04	TW: 50 Marks
		Oral : 50 Marks

Each student is required to deliver a Seminar on state of the art topic of his/her choice relevant to any area of Production Engineering and submit it in the form of short report.

611101: Computational Intelligence in Tool Design

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 4 hours / week	Theory: 04	In-Sem: 50 Marks
		End-Sem : 50 Marks

Objectives:

To demonstrate the effectiveness of artificial intelligent techniques to solve complex issues related to tool design

Outcome:

Student will be able to apply artificial intelligent techniques to deal with various practical issues in tool design such as:

- Automatic configuration of tooling,
- Process planning in tool design,
- Material flow analysis
- Defect analysis

Unit I:

Fixture design

Applications of AI techniques for fixturing constraint analysis, Workpiece locating and Clamping stability analysis, determination of magnitude and number of clamps, Workpiece deformation under clamping and machining force. Fixture structural stiffness, applications of CAFD

Unit II:

Press tool design

Applications of AI techniques for process planning in progressive dies, feature extraction and manufacturability assessment of sheet metal parts, automatic blank nesting, force calculations, forming analysis, optimization of spring back in bending & drawing operations, prediction of life of compound die.

Unit III

Forging die design

Applications of AI techniques for process planning of forging impressions, Determination of parting line, forging force analysis, material flow analysis in forging operations, computer aided forging die design.

Unit IV

Injection mould design:

Applications of AI techniques for determination of number of impressions, analysis of cooling system, mold flow analysis and solidification, defect analysis, cavity balancing, gating system design, computer aided injection mould design.

Unit V

Metal casting die design

Applications of AI techniques in cavity layout design, gating system design and analysis, solidification control, automatic generation side cores, material flow analysis, defect analysis, parting line selection, computer aided die casting die design.

Unit VI

Sand casting mold design

Model representation and verification, casting solidification, vector element method, mould filling analysis, optimal filling time, optimal design of feeding system. Product design for castability.

References:

1. Nee A Y C., Whybrew K., Senthil Kumar A., "Advanced fixture design for FMS", Springer-Verlag, NY. ISBN: 978-1-4471-2119-0
2. Yiming Rong, "Computer-Aided Fixture Design", Manufacturing Engineering and Materials Processing Series/55, CRC Press. ISBN: 9780824799618
3. Carlos B. Bergmann, "AI applications in sheet metal forming", Springer, ISBN:9789811022517
4. Weinstein M, Manoochehri S., "Optimum parting line design of molded and cast parts for manufacturability", Journal of Manufacturing Systems, Volume 16(1), 1997, pp. 1-12.
5. Šraml M , Stupan J, Potrč I, Kramberger J., "Computer-aided analysis of the forging process, The International Journal of Advanced Manufacturing Technology, Volume 23 (3), pp. 161–168
6. Fuh J.Y.H., Fuh M. W., Nee A.Y.C., "Computer-Aided Injection Mold Design and Manufacture", CRC Press, ISBN 9780824753146
7. Ravi B., "Metal Casting: Computer - Aided Design and Analysis", Prentice-Hall India Learning Pvt. Ltd, ISBN-13: 978-8120327269

611102: Mechatronics

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 4 hours / week	Theory: 04	TW: 50 Marks
		Oral : 50 Marks

Course objectives:

- Develop an understanding of the basic elements underlying mechatronic systems: measurement systems, sensors, actuators, microprocessors.
- Understand how to interface electromechanical systems to microcontrollers.
- Developing understanding of Process Control Computer Systems.
- Gain hands-on experience with commonly used electronic test and measurement instrumentation.

Course Outcomes:

The Student will be able to –

- Define the Mechatronics systems, measurement and control system.
- Understanding various sensors and transducers and their applications.
- Describe the architecture, configuration and interfacing of Microprocessor.
- Understand the Mini, Micro Computer process and Digital processes.
- Analyze the logic of Programmable logic controllers and state their applications.
- Illustrate the advanced applications in Mechatronics.

Unit I

Introduction

Introduction to Mechatronics - Systems - Mechatronics in Products – Measurement Systems - Control Systems -Traditional design and Mechatronics Design.

Unit II

Sensors And Transducers

Introduction - Performance Terminology - Displacement, Position and Proximity -Velocity and Motion – Fluid pressure - Temperature sensors - Light sensors - Selection of sensors - Signal processing - Servo systems.

Unit III

Microprocessors In Mechatronics

Introduction - Architecture - Pin configuration - Instruction set - Programming of Microprocessors using 8085 instructions - Interfacing input and output devices - Interfacing D/A converters and A/D converters –Applications - Temperature control - Stepper motor control - Traffic light controller.

Unit IV

Process Control Computer Systems

Minis, micros, classification by hardware features and software facilities, performance evaluation techniques. Characteristics of Digital Processors: Organization, instruction set, characteristics for process control, input/output arrangements, addressing techniques, memory systems.

Unit V

Programmable Logic Controllers

Introduction - Basic structure - Input / Output processing - Programming –Mnemonics Timers, Internal relays and counters - Data handling - Analog input / output - Selection of PLC.

Unit VI

Design and Mechatronics (Mechatronic Product Design)

Designing - Possible design solutions - Case studies of Mechatronics systems.

References

1. Michael B.Histand and David G. Alciatore, "Introduction to Mechatronics and Measurement Systems", McGraw-Hill International Editions, 1999.ISBN: 0070648142
2. Ramesh. S Gaonkar, “Microprocessor Architecture, Programming and Applications ", Wiley Eastern, 1998. ISBN:0130195707
3. Ghosh, P.K. and Sridhar, P.R., 0000 to 8085, "Introduction to Microprocessors for Engineers and Scientists ", Second Edition, Prentice Hall, ISBN:8120309782
4. Bolton, “Mechatronics: Electronic Control System in Mechanical and Electrical Engineering”, Pearson Education Ltd. ISBN:8131732533
5. Dr. Appukuttan, “Introduction to Mechatronics”, Oxford University Press, India, ISBN: 0195687817

11103A: Tribology and Surface Engineering–(Elective III)

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 5 hours / week	Theory: 05	In-Sem: 50 Marks
		End-Sem : 50 Marks

Objectives:

- To provide detail about the concepts of friction, wear, surface treatment processes, and lubrication affecting the structure and behavior of contacting surfaces, their nature and topography
- Enable students to perform tribological measurements to practice tribological design of mechanical elements and systems

Outcomes:

Students will be able to

- Describe theories of sliding and rolling friction
- State wear and corrosion mechanisms
- Apply the knowledge of lubrication for the design of various bearings
- Perform tribological measurements
- Explain the structure of surfaces.
- Define various surface treatment processes
- Select and apply appropriate surface treatment method for corrosion prevention

Unit I:

Friction Wear and Corrosion

Theory of friction- sliding and rolling friction, Tabor'smodel of friction, Friction properties of metallic and non metallic materials, friction in extreme conditions, Wear, types of wear, mechanisms of wear, wear resistant materials, Mechanisms and types of corrosion, Measurement and testing of Friction, Wear and Corrosion, Prevention of wear and Corrosion.

Unit II

Lubrication Theory

Lubricants and their physical properties, lubricants standards, Lubrication regimes, Hydrodynamic lubrication, Reynolds equation, Thermal, inertia and turbulent effects, Elasto, Plasto and magneto hydrodynamic lubrication, Hydrostatic, Gas lubrication. Design of fluid film bearings, Design of air bearing and gas bearing

Unit III

Tribo Measurement and Instrumentation:

Surface topography measurements, Electron-microscope, Laser method, Instrumentation, International Standards, Bearing performance measurements, Bearing Vibration Measurement

Unit IV

Introduction to Surface Engineering

Concept and Scope of Surface Engineering, Mathematical modeling and manufacturing of surface layers, The solid surface-geometrical , mechanical and physico chemical concept, Three dimensional structure of surface, The superficial layer and its parameters.

Unit V

Surface engineering for wear and corrosion resistance:

Diffusion Coatings, Electro and Electro-less plating, Hot dip coating, Metal Spraying, Cladded coatings, Crystallizing coatings, Flame and arc processes, Conversion coatings, selection of coatings for wear and corrosion resistance, Potential properties and parameters of coatings.

Unit VI

Thin Layer Engineering Processes:

Laser and electron beam hardening, its process parameters and their effects, Physical vapor deposition, Thermal evaporation Arc vaporization, Sputtering, Chemical vapor deposition, ion implantation technique, Coating of tools, TiC, TiN, Al2O3 and Diamond coating properties, applications of thin Coatings

Reference Books:

1. Hulling J. “Principles of Tribology” McMillan, 1984
2. Williams J.A. “Engineering Tribology” Oxford Univer sity press, 1994.
3. Davis J. “Surface Engineering for corrosion and Wear Resistance”, Wood head Publishing, 2001.
4. Tadausz Burakowski, “Surface Engineering of Metals: Principles, Equipments, Tehnologies” Taylor and Francis.

611103B: Engineering Economics and Costing–(Elective III)

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 5 hours / week	Theory: 05	In-Sem: 50 Marks
		End-Sem : 50 Marks

Course Objectives:

To provide information on fundamentals of Financial, Economical and Costing for any manufacturing industry.

Course Outcomes:

- Understand the importance of Finance & methods of Costing.
- Describe Investment proposal from short term & Long term decisions.
- Prepare costing sheet.

Unit I

Introduction to Economics

Concept of Engineering Economics – Engineering efficiency, Economic efficiency, Scope of engineering economics, Managerial, Economics and Macro-economics - Applications of Economics, Elementary economic Analysis – Material and design selection criteria, Process planning.

Unit II

Financial Management

Responsibilities and functions of financial management, financial analysis, ratio analysis, leverage analysis, budgeting and budgetary control, sources of finance for fixed and working capital.

Unit III

Investment Appraisal Methods

Types of investment appraisal methods – present worth method (Revenue dominated cash flow diagram), Future worth method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), Annual equivalent method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), rate of return method, make or buy decisions, Examples in all the methods, risk analysis.

Unit IV

Replacement and Maintenance Analysis

Types of maintenance, types of replacement problem, determination of economic life of an asset, Replacement of an asset with a new asset – capital recovery with return and concept of challenger and defender, Simple probabilistic model for items which fail completely.

Unit V

Depreciation Analysis

Introduction, Straight line method of depreciation, declining balance method of depreciation-Sum of the years digits method of depreciation, sinking fund method of depreciation/ Annuity method of depreciation, machine hour basis method, production unit method, joint factor rate method, annuity method, service output method of depreciation-Evaluation of public alternatives- introduction, Examples,

Inflation adjusted decisions – procedure to adjust inflation, Examples on comparison of alternatives and determination of economic life of asset.

Unit VI

Costing, Cost Control and Cost Reduction

Process costing: Elements of production cost in process costing, methods of process costing, principles of process costing. Marginal costing: Features of marginal costing, significance of marginal costing, break even point, P/V ratio. Standard costing and variance analysis: Direct material variances, direct labor variances, Overhead variances, sales variances. Cost control and cost reduction, Techniques of cost control, cost reduction, areas of application.

REFERENCES:

1. Dominick Salvatore, "Managerial economics in a global economy" McGraw-Hill. ISBN: 0070545995
2. Panneer Selvam, R, Engineering Economics, Prentice Hall of India Ltd, New Delhi, 2001.ISBN: 8120317432
3. Sasmita Mishra, Engineering Economics and Costing. PHI Learning Pvt. Ltd. ISBN: 8120338936
4. Chan S.Park, "Contemporary Engineering Economics", Prentice Hall of India, 2002. ISBN: 0136118488
5. William G. Sullivan, Elin Wicks and C.Patrick Koelling Engineering economy, Pearson Education, ISBN:9788131734421

611103C: Human Factor in design and Manufacturing–(Elective III)

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 5 hours / week	Theory: 05	In-Sem: 50 Marks
		End-Sem : 50 Marks

Course objectives:

- To understand the user's (human) capabilities and limitations in seeking to ensure the tasks (job), functions, information and the environment.
- To study of humans anthropometry, biomechanics, industrial engineering, information design, human psychology

Course outcomes:

- Student will able to design industrial and consumer product by using ergonomic principles.
- Student will able to design work space and equipment used (size, shape, displays & controls) for the activity to be performed;,
- Student will able to analyse the effect of working conditions on human performance.

Unit I:

Introduction to Human Factors

Human criteria's, human physical activities, features of the human body, Measures of physiological functions such as: energy expenditure, gross body activity, local muscular activity, work load, work efficiency, work and rest. Type of movements of body members. Performance criteria for physical activity such as: Strength & endurance speed of movements, accuracy of movements, manual material handling (MMH).

Unit II:

Applied Anthropometry and Work Space

Introduction to anthropometry, use & principles of anthropometry data, work spaces, work space envelopes for seated persons, design of work spaces such as: work surface height, seated & standing, principles of seat design, workplace design. Physical space & arrangement, principles of arrangement of component.

Unit III:

Design of Displays and Controls

Information input & processing, visual displays of static & dynamic information. Auditory, textual & olfactory displays general location of controls & displays within workspace, concept of visibility. Functions of controls, types of controls, factors in control design, design of specific hand operated controls, foot controls and special control devices.

Unit IV:

Working Condition

Illumination: Colour systems, energy consideration, effect of lighting on performance. Atmospheric conditions: Measurement of thermal variables, wet-bulb globe temperature, Botsball, heat stress index,

heat index, wind chill index, physiological effect of heat & cold on performance. Noise: Physiological effect of noise on performance, noise exposure limits, noise controls.

Unit V:

Energy Expenditure

Muscle mechanism, BMR, Heart Rate variations, Oxygen consumption, Rest allowances, Rate of energy expenditure, Manual Material Handling Capacity determination, Effect of environmental conditions and work design on Energy Expenditure.

Unit VI:

Ergonomics and Work Organization

Human factors and ergonomics standards, Human factors applications in system design, characteristics of system design, human factors data for interface design, ergonomic safety and health management, case studies of ergonomically designed product.

Text Books

1. Sanders M. S. and McCormick E. J., "Human Factors in Engineering and Design", McGraw-Hill International Editions, 2. Bridger R. S., "Introduction to Ergonomics", McGraw-Hill International Editions

Reference Books:

1. Gavriel Salvendy (Ed.)., 'Handbook of human factors and ergonomics", 3rd Edition, John-Wiley and Sons

611103D: Energy Management –(Elective III)

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 5 hours / week	Theory: 05	In-Sem: 50 Marks
		End-Sem : 50 Marks

Course objective:

- Apply concepts of thermal engineering including thermodynamics, heat transfer and fluid mechanics to design and develop energy efficient equipment.
- Adopt methods of energy conservation for sustainable development in various equipments.
- To gather knowledge on energy auditing techniques used for energy systems.
- To work on efficient energy systems used in various electrical lighting systems.
- To understand the concept of the cogeneration, trigeneration and waste heat recovery.

Outcomes:

- Ability to understand the basic concept of energy conservation and its role in energy management.
- Learn the purpose and detailed methodology of energy audit.
- Ability to analyze the energy conservation opportunities in the energy intensive industries.
- Ability to analyze the quantum of electrical energy that can be saved by the use of energy efficient lighting systems.
- Learn the concept of cogeneration, trigeneration and waste heat recovery in detail.

Unit I

Energy Scenario

Global primary energy reserves and consumption pattern, Indian energy scenario, sector wise energy consumption, energy needs of growing economy, energy pricing in India, energy security importance of energy conservation and introduction of energy conservation act 2001.

Unit II

Energy Economics and Energy Audit

Energy economics: Simple payback period, time value of money, return on investment, net present value and internal rate of return. Energy Audit: Methodology, analysis and reporting, portable and online instruments required for energy audit, sankey diagram and specific energy consumption.

Unit III

Thermal Systems

Boiler efficiency calculations by direct and indirect method, various losses, steam distribution and steam traps, energy conservation opportunities in boiler. Efficiency calculation of oil fired furnace, heat losses and energy conservation opportunities in furnace. Thermal insulation, types of insulation, economic thickness of insulation.

Unit IV

Electrical Systems

Demand control, billing structure, power factor improvement, benefits and ways of improving PF, load scheduling, electric motors, losses and efficiency, energy efficient motor, speed control methods of motor, Lighting: illumination level, fixtures, timers, energy efficient illumination.

Unit V

Energy Conservation

Energy conservation in: Compressed air systems, refrigeration and air conditioning systems, pumps, fans, D. G. set and cooling tower.

Unit VI

Cogeneration and Waste Heat Recovery

Cogeneration: Concept, technical options, classification of cogeneration system i.e. topping and bottoming cycle, selection criteria, applications. Waste Heat Recovery: Introduction, classification and applications, benefits, waste heat recovery equipments i. e. recuperator, regenerator, economizer, heat wheel, heat pipe, thermo-compressor, heat pump.

References

1. Guide books 1, 2 and 3, Bureau of Energy Efficiency.
2. Practical Energy Audit Manual, Indo –German Energy Efficient Project, Tata Energy Research Institute (TERI).
3. Albert Thumann, Plant Engineers and Managers Guide to Energy Conservation, CRC Press.
4. I. G. C. Dryden , The Efficient Use of Energy, IPC Science and Technology Press.
5. S. C. Tripathy, Electric Energy Utilisation and Conservation, Tata McGraw-Hill Publishing Company Ltd.
6. P. H. Henderson: India- The Energy sector, Oxford University Press.
7. W. C. Turner, editor: The efficient use of energy (Butterworths)
8. Frank Keith, Yogi Goswami, “Enegy Management and End use Efficiency Handbook” Taylor and Francis.
9. Donald A. Wulfinghoff, Energy Efficiency Manual, Energy Institute Press.

611104: Seminar II

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 4 hours / week	Theory: 04	TW: 50 Marks
		Oral: 50 Marks

Each student is required to review the literature related to proposed dissertation work to be done. He/she is required to deliver the seminar and submit it in the form of short report.

611105: Project Work Stage I

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 4 hours / week	Theory: 08	TW: 50 Marks
		Oral: 50 Marks

Student has to submit a report based upon the following:

- Objective of the Project
- Progress Achieved
- Difficulties encountered
- Experimental set up preparation
- Methodology and data analysis
- Future plan of action

611106: Seminar III -2017

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 5 hours / week	Theory: 05	TW: 50 Marks
		Oral: 50 Marks

Each student is required deliver a seminar based on proposed dissertation work to be done andsubmit it in the form of short report. The report should include analytical treatment andmathematical formulation of the problem identified for the dissertation work.

611107 : Project Work Stage II

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 20 hours / week	Theory: 20	TW: 150 Marks
		Oral: 50 Marks

Student has to submit a report based upon the following:
1. Objectives of work
2. Review of literature
3. Development of methodology
4. Experimental and numerical analysis.
5. Results obtained.
6. Comparison of results with previous work done