Department of Mechanical Engineering

CURRICULUM AND SYLLABUS

(2023-2027)

M. Tech. (Executive) Manufacturing Engineering

Mechanical Engineering

M. Tech. (Executive) in Manufacturing Engineering

CURRICULUM AND SYLLABUS

Vision Statement of University

Be an internationally acclaimed University recognized for its excellent teaching, research, innovation, outreach and creating top class technocrats and professionals who can serve the mankind as multi skilled global citizen.

Mission Statement of University

- Establish state-of-the-art facilities for world class education and research.
- Conduct scholarly research and creative endeavours that impact quality of life.
- Attract quality staff and students to cater for diverse needs and preferences and widen participation.
- Build a foundation for students to be successful at all levels through high-quality, innovative programs.
- Collaborate with institute, industry, and society to address current issues through research and align curriculum.
- Involve in societal outreach programs to identify concerns and provide sustainable ethical solutions.
- Encourage life-long learning and team-based problem solving through an enabling environment.

Vision of the Department:

To develop engineers of par excellence to meet the ever-changing requirements of industries, motivated towards innovation, entrepreneurship and research in mechanical and allied engineering along with strong human values and ethics for the benefit of society and nation at large.

Mission of the Department:

1. To offer a platform to the students where they will be able to groom themselves technically as industry ready professionals.
2. To develop research environment where students will be motivated to enhance their knowledge to undertake research in mechanical and allied engineering.

3. To collaborate with industries, education institutes of excellence and alumnus to share and exchange latest technology and innovation.
4. To design curriculum to motivate and sensitize students towards environmental issues and respect for human values and ethics.
5. To develop conducive academic environment in the department to attract qualified faculties members from all around the country.

Department of Mechanical Engineering

Program Education Objectives (PEOs)

PEO -1	To provide advanced knowledge for finding solutions of complex prac
PEO-2	To develop research acumen for designing a system with better efficie
PEO-3	To prepare students as experts with better communication skills, p team spirit for working in multidisciplinary teams.

Department of Mechanical Engineering

PROGRAMME OUTCOMES (POs)

After the completion of programme, student shall be able to:-

PO01	**Engineering knowledge**: Apply the knowledge of mathematic engineering fundamentals, and an engineering specialization to the complex engineeringproblems.
PO02	**Problem analysis**: Identify, formulate, research literature, and analy engineering problems reaching substantiated conclusions using first p mathematics, natural sciences, and engineering sciences.
PO03	**Design/development of solutions**: Design solutions for complex engineerin anddesign system components or processes that meet the specified needs with consideration for public health and safety, and the cultural, societal, and en considerations.
PO04	**Conduct investigations of complex problems**: Use research-based knc research methods including design of experiments, analysis and interpreta and synthesis of the information to provide valid conclusions.
PO05	**Modern tool usage**: Create, select, and apply appropriate techniques and modern engineering and IT tools including prediction and modeling engineering activities with an understanding of the limitations.
PO06	**The engineer and society**: Apply reasoning informed by the contextual to assess societal, health, safety, legal and cultural issues and the responsibilities relevant to the professional engineering practice.
PO07	**Environment and sustainability**: Understand the impact of professional solutions in societal and environmental contexts, and demonstrate the knc and need for sustainable development.
PO08	**Ethics**: Apply ethical principles and commit to professional ethics and res and norms of engineering practice.
PO09	**Individual and team work**: Function effectively as an individual, and a or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication**: Communicate effectively on complex engineering activiti engineering community and with society at large, such as, being able to comp write effective reports and design documentation, make effective present give and receive clear instructions.

PO11	**Project management and finance**: Demonstrate knowledge and unde the engineering and management principles and apply these to one's own memberand leader in a team, to manage projects and in multidisciplinary envi
PO12	**Life-long learning:** Recognize the need for, and have the preparation a engage in independent and life-long learning in the broadest context of t change.

Department of Mechanical Engineering

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO 1: Acquire, Develop and Demonstrate knowledge in the area of Automobile Automotive Systems, Machine Component Design, Finite Element Method, Engineering, Manufacturing and Development of Mechanical system.

PSO 2: Apply concepts of learning, Managerial skills, Computational skills and I methodologies, techniques & tools to solve Industrial problems and become a su Entrepreneur.

PSO 3: Develop the ability to automate a mechanical system or a process to mee needs within realistic constraints such as health, safety and manufacturability.

PSO 4: Apply the research-based knowledge and research methods including d experiments, analysis and interpretation of data.

Medi-Caps University, Indore
Scheme of M. Tech. -Manufacturing Engineering
For the candidates admitted in session 2023-27

Semester I

S.No.	Course Code	Course Name	L	T	P	Credits
1	ME5BS01	Mathematics	4	0	0	4
2	ME5CM02	Advanced Manufacturing Technology	4	0	4	6
3	ME5PC03	Minor Project-I	0	0	16	8
4	EN5RD01	Research Methodology	4	0	0	4
		Total	**12**	**0**	**20**	**22**
		Total Contact Hours	**32**			

Semester II

S.No.	Course Code	Course Name	L	T	P	Credits
1	ME5EL11	Elective I: Artificial Intelligence in Manufacturing	4	0	0	4
2	ME5CA01	Finite Element Method	4	0	4	6
3	ME5EL12`	Elective II: Metal Forming and Joining Processes	4	0	0	4
4	ME5PC04	Minor Project-II	0	0	16	8
		Total	**12**	**0**	**20**	**22**
		Total Contact Hours	**32**			

SEMESTER – III

Sr.No.	Course Code	Course Name	L	T	P	Credits
1	ME5CM05	Metallurgical Thermodynamics	4	0	4	6
2	ME5EL13	Elective III: Metrology and Inspection	4	0	0	4
3	EN5HS02	Technical Paper writing	0	0	2	1
4	EN5MC01	Value and Ethics	2	0	0	2
5	ME5PC05	Dissertation Phase-I	0	0	20	10
		Total	**10**	**0**	**26**	**23**
		Total Contact Hours	**36**			

SEMESTER – IV

Sr.No.	Course Code	Course Name	L	T	P	Credits
1	ME5CM06	Advanced Machining Processes and Tool Design	4	0	4	6
2	EN5HS01	Entrepreneurship and Management	3	0	0	3
3	ME5PC06	Dissertation Phase-II	0	0	32	16
		Total	**7**	**0**	**36**	**25**
		Total Contact Hours	**43**			

L : Lecture T : Tutorial P : Practical

Total Credits with NG Courses	**92**

SEMESTER – I

Sr. No.	Course Code	Course Name	L	T	P	Hours	Credits
1	ME5BS01	Mathematics	4	0	0	4	4
2	ME5CM02	Advanced Manufacturing Technology	4	0	4	8	6
3	ME5PC03	Minor Project-I	0	0	16	16	8
4	EN5RD01	Research Methodology	4	0	0	4	4
		Total	**12**	**0**	**20**	**32**	**22**

Subject Code	Subject Name	Hours per Week			Hours	Credits
		L	T	P		
ME5BS01	Mathematics	4	0	0	4	4

Course Objectives:

1. To equip with the fundamental concepts in vector spaces.
2. To learn how to distinguish different types of numerical methods to solve simultaneous equations and ordinary differential equations.
3. To understand different classification of partial differential equations and finite difference concept to solve PDE.
4. To equip with the fundamental concepts in discrete Fourier transform with algorithm to find it.
5. To solve practical problems in probability distribution and reliability.

Unit-I

Linear algebra: Vector spaces, subspaces, Sum and direct sum of subspaces, Linear span, Linear dependence, independence and their basic properties, Basis, Linear transformations and their representation as matrices, the algebra of linear Transformations, The rank- nullity theorem, Eigen value analysis.

Unit-II

Numerical Methods: Solution of linear system of algebraic equation solution using Gauss elimination and Gauss sedial methods, ill conditioned matrix, method to improve accuracy of ill conditioned system, Power method to solve Eigen value problems. Concept of explicit and implicit methods ,Solution of differential equation using multi-step methods: Runge-Kutta and Predictor-Corrector methods, shooting method to solve boundary value problems, Lagrange interpolation, splines interpolation.

Unit-III

Partial differential equations: Characteristics and classification of second order PDEs. Separation of variables. Numerical solution of PDE(Laplace , Poisson, Heat, Wave) using finite difference methods: Elliptic partial differential equations, Parabolic PDE, Crank–

Nicholson Method(Two-Dimensional Parabolic PDE), Hyperbolic PDE (Two-Dimensional Hyperbolic PDE).

Unit-IV

Fourier transform: Review of Fourier transform, Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT), Short time Fourier Transform(STFT) and their properties .

Unit-V

Probability distribution and Reliability: Probability distribution with the Concept of continuous distribution functions, Normal distribution, Exponential distribution, Memory less property, Hypo exponential, Weibull distribution. Introduction to reability, Measure of reliability, reliability functions, derivation of reliability function, failure rate and failure models, mean time to system failure (MTSF), Failure time distribution. System configuration: series and parallel, k out of n systems, Redundancy.

Text/Reference Books

1. S. P. Venkateshan, PrasannaSwaminathan, Computational Methods in Engineering, Ane Books
2. Steven C. Chapra, Numerical Methods for Engineering, Mc-Graw Hill Education.
3. Gilbert Strang, Computational Science and Engineering, Wellesley-Cambridge Press.
4. B. S. Grewal, Higher Engineering Mathematics, Khanna Publ.
5. T. Veerajan , Probability, Statistics and Random Processes, Tata McGraw Hills, New
6. Delhi, 2002.
7. E. Balagurusamy, Reliability Engineering, Tata McGraw-Hill Education, 1984.
8. A.k. Sharma, Linear Algebra, , Discovery Publishing House, 2007.
9. ShrinivasanKeshav ,Mathematical Foundation of computer networking , Pearson Eduaction, 2013.

Course Outcomes:

After completion of this course the students shall able to:

CO 1. Well understand and remember the fundamental concept of Vector spaces, subspaces, , Linear dependence, independence , numerical concept , PDE and Fourier transform , probability and reliability.

CO 2. Apply and Implement the numerical concept in solution of simultaneous , ordinary and partial differential equation by explicit and implicit methods.

CO 3. Analyze the system on basis of probability to check reliability.

CO 4. Evaluate the Fourier transform of functions and follow FFT algorithms.

Subject Code	Subject Name	Hours per Week			Hours	Credits
		L	T	P		
ME5CM02	**Advanced Manufacturing Technology**	4	0	4	8	6

Course Learning Objectives (CLOs)

CLO01: Students must be acquainted with the various unconventional manufacturing processes.
CLO02: Students must know about the applications of advanced manufacturing processes.
CLO03: Student must be encouraged for developing the models of advanced manufacturing processes.
CLO04: Students must be able to apply theknowledge of wide applications of AM in industry and society; and in particular, key applications of AM such as rapid tooling, medical AM and rapid manufacturing.
CLO05: Students must be aware of the technology for conceptual modelling, prototyping and rapid manufacturing.

Course Outcomes (COs)

CO01: Students will be able to select between a subtractive and an AM process for a particular application.
CO02: Students will be able to solve the various problems for the given profiles to be imparted on the work specimens.
CO03: Students will be able toanalyze the processes and evaluate the role of each process parameter during machining of various advanced materials.
CO04: Students will be able to select the best process out of the available various advanced manufacturing processes for the given job assignment.
CO05: Students will be able to understand the requirements to achieve maximum material removal rate and best quality of machined surface while machining various industrial engineering materials.

Unit-I

Traditional Metal Cutting Technology: Introduction to metal cutting - tool nomenclature and cutting forces - Thermal aspects of machining - Tool materials - Tool life and tool wear, High speed machining, Limitations of traditional metal cutting processes, Introduction and classification of Advanced machining processes

Unit-II

Mechanical Type Processes: Abrasive Jet Machining (AJM), Principle of AJM, Process characteristics, Process parameters and their effect on metal removal rate, Abrasive Jet Machining Setup, Process capabilities and applications. **Water Jet Machining (WJM)**: Principle of WJM, Process characteristics, Process parameters and their effect on metal removal rate, Water Jet Machining Setup, Process capabilities and applications **Ultrasonic Machining (USM)** : Principle of WJM, Process characteristics, Process parameters and their effect on metal removal rate MRR, Ultra Sonic Machining Setup, Process capabilities and applications **Abrasive Water Jet Machining (AWJM)** : Principle of WJM, Process characteristics, Process parameters and their effect on metal removal rate, Ultra Sonic Machining Setup, Process capabilities and applications. Comparison of above processes.

Unit-III

Thermo-Electric Type Processes: Electric Discharge Machining (EDM) , Principle of EDM, Process characteristics Process parameters and their effect on metal removal rate, R-C Pulse Generator and its analysis, EDM Machining Setup, Process capabilities and applications. **Wire Cut EDM**: Principle of Wire Cut EDM, Process characteristics, Process parameters and their effect on metal removal rate, Wire EDM Machine Advances in Wire cut, Process capabilities and applications. **Laser beam Machining**: Principle of LBM, Types of Lasers for machining and their production, Process characteristics, Process parameters and their effect on metal removal rate, Machining set up, Process capabilities and applications. **Electron Beam Machining**: Principle of EBM, Process characteristics Process parameters and their effect on metal removal rate, EBM Machining Setup, Process capabilities and applications. **Plasma Arc Machining**: Principle of PAM, Process characteristics Process parameters and their effect on metal removal rate, PBM Machining Setup, Process capabilities and applications. Comparison of above processes.

Unit-IV

Chemical and Electro-Chemical Type Processes: **Chemical Machining**: Principle of CM, Process characteristics, Process parameters and their effect on metal removal rate, Machining set up, Process capabilities and applications. **Electro-Chemical Machining**: Principle of ECM, Faraday's law of Electrolysis, ECM Machine Tool, process characteristics, Anode Shape Prediction –Cosθ Method , Empirical Approach - Nomographic Approach - Numerical Approach Tool (Cathode) Design for ECM Process- Cosθ Method, Correction Factor Method, Process parameters and their effect on metal removal rate, Process capabilities and applications.

Laser assisted ECM: Principle of LAECM, Process characteristics, Process parameters, Machine set up, Process capabilities and applications, Comparison of above processes.

UNIT V

Advanced Finishing Processes: Mechanical Type Processes, Abrasive Flow Finishing (AFF): Principle of AFF, Process characteristics, Process parameters and their effect on surface finish, AFF Machining Setup, Process capabilities and applications. Analysis and modelling of Abrasive flow machined surfaces.

Magnetic Abrasive Finishing (MAF): Principle of MAF, Process characteristics, Process parameters and their effect on surface finish, MAF Setup, Process capabilities and applications. Analysis and modelling of Abrasive flow machined surfaces - Number of Active Grains - Wear of Abrasive Grains. Thermo-Electric Type Finishing Processes:

Electric Discharge Grinding (EDG): Principle of EDG, Process characteristics, Process parameters and their effect on surface finish, EDG Setup, Process capabilities and applications. Electro-Discharge Diamond Grinding (EDDG): Principle of EDDG, Process characteristics, Process parameters and their effect on surface finish, EDDG Setup, Process capabilities and applications.

Electro-Chemical Type Processes: Electro-Chemical Grinding (ECG): Principle of ECG, Process characteristics, Process parameters and their effect on surface finish, ECG Setup, Process capabilities and applications.

Electro Chemical Deburring (ECD): Burrsand their types, Basic approach on de-burring, classification of de-burring process, Principle of Electro-chemical debarring, Process

parameters and their effect on surface finish, ECD set up, Process capabilities and applications.

References

1. V.K. Jain, Advanced Machining Processses, Allied Publishers, 2009
2. P.K. Mishra ,Non Conventional machining, Narosa India Publications, 1997
3. P C Pandey and H S Chan Modern Machining Processes, Tata McGraw Hill Publications
4. Bhattacharya "Metal Cutting Theory and Practice", New Central Book Agency (P) Ltd., Calcutta1984.
5. Hassan Abdel – Gawad El-Hofy "Advanced Machining Processes", McGraw, New York, 2005.
6. Wellar, E.J. "Non-Traditional Machining Processes", Society of Manufacturing Engineers Publications, 2nd Edition, Michigan, 1984.
7. Metals Handbook. Vol. 16, Machining. Materials Park; OH: ASM International, 1995.
8 .Kalpakjian, S "Manufacturing Process for Engineering Materials", MA:Addison- Wesley, 1997.
9. Brown, J "Advanced Machining Technology Handbook", New York: McGraw-Hill, 1998.
10. McGeough, J "Advanced Methods of Machining", London. New York: Chapman and Hall, London, 1988.
11. Rumyantsev, E and Davydov, A "Electrochemical Machining of Metals", Moscow:Mir Publishers, 1984.

List of Experiments

1. Face milling operation on given specimen.
2. Slotting operation on given work piece.
3. Making a pocket on given work piece.
4. Making a spigot on given work piece.
5. Drilling operation as required.
6. Pick & place operation by robotic arm.

Subject Code	Subject Name	Hours per Week			Hours	Credits
		L	**T**	**P**		
ME5PC03	**Minor Project-I**	0	0	16	16	8

Students should model, analyze and animate /fabricate a functional model of any component, sub system or a mechanism used in automobile. They should prepare a mini project report and submit it.

Subject Code	Subject Name	Hours per Week			Hours	Credits
		L	T	P		
EN5RD01	**Research Methodology**	4	0	0	4	4

Unit-I

Introduction to Research Techniques : Meaning of research, objectives of research, motivation in research, types of research-Introduction to experimental test bed, algorithmic research, simulation research, mathematical modelling approach, characteristics and prerequisites of research, significance of research, research process, Sources of research problem, criteria of identifying the problem, necessity of defining the problem, errors in selecting research problem, technique involved in defining the problem, Report and paper writing.

Unit-II

Scientific Research and Statistical analysis: Introduction: Nature and objectives of research, types and methods of research; empirical and experimental research, study and formulation of a research problem. Statistical analysis: Measures of central tendency and dispersion,-mean, median, mode, range, mean and standard deviations, computing correlation in variables, linear and non-linear regression.

Unit-III

Probability and Probability distributions: Classical, relative frequency and axiomatic definitions of probability, addition rule and conditional probability, multiplication rule, total probability, Bayes'Theorem and independence. Probability distributions: binomial, poison, geometric, negative binomial uniform exponential, normal and log normal distribution.
Random Variables: Discrete, continuous and mixed random variables, probability mass, probability density and cumulative distribution functions, mathematical expectation, moments, probability and moment generating function, median and quintiles, Markov inequality, correlation and regression, independence of random variables.

Unit-IV

Sampling &Distributions: Central Limit Theorem, distributions of the sample mean and the sample variance for a normal population, Chi-Square, t and F distributions, problems. Hypothesis Testing: Basic ideas of testing hypothesis, null and alternative hypotheses, the critical and acceptance regions, two types of error, tests for one sample and two sample problems for normal populations, tests for proportions, Chi-square goodness of fit test and its applications. Software and Tools to be learnt: Statistical packages like SPSS and R.

Unit-V

Simulation and Soft Computing Techniques: Introduction to soft computing, Artificial neural network, Genetic algorithm, Fuzzy logic and their applications, Tools of soft computing, Need for simulation, types of simulation, simulation language, fitting the problem to simulation study, simulation models, verification of simulation models, calibration and validation of models, Output analysis. Introduction to MATLAB, NS2, ANSYS, Cadence etc(Department Specific).

Reference Books

1. R. Panneerselvam, " Research Methodologies," PHI.
2. Best John V. and James V Kahn: Research in Education, Wiley eastern, 2005.
3. S.P. Sukhia, P.V. Mehrotra, and R.N. Mehrotra: Elements of Educational Research, PHI publication, 2003.
4. K. Setia: Methodology of Research Education, IEEE publication, 2004.
5. C.R. Kothari: Research methodology, Methods and Techniques, 2000.
6. Jerry Banks, John S. Carson, Barry.L. Nelson David. M. Nicol, " Discrete-Event System Simulation", Prentice-Hall India.
7. V.K. Rohatgi, A.K. Md.E.Saleh, An Introduction to Probability and Statistics, Johm Willey, 2011.
8. S.M. Ross, A First Course in Probability, 8 th Edition, Prentice Hall, 2009

SEMESTER II

Sr. No.	Course Code	Course Name	L	T	P	Hours	Credits
1	ME5EL11	Elective I: Artificial Intelligence in Manufacturing	4	0	0	4	4
2	ME5CA01	Finite Element Method	4	0	4	8	6
3	ME5EL12`	Elective II: Metal Forming and Joining Processes	4	0	0	4	4
4	ME5PC04	Minor Project-II	0	0	16	16	8
		Total	**12**	**0**	**20**	**32**	**22**

Subject Code	Subject Name	Hours per Week			Hours	Credits
		L	T	P		
ME5EL11	**Artificial Intelligence in Manufacturing** (Elective I)	4	0	0	4	4

Course Learning Objectives (CLOs)

CLO01: Students should understand the basic concepts of artificial intelligence and its components

CLO02: Students must understand the basics of Neural Computing and concept of learning and training.

CLO03: Students must able to understand the neural network and learning algorithms for perceptron and different networks

CLO04: Students must understand the concept and develop fuzzy logic for different applications

CLO05: Students must understand the concept of Expert System and its role in solving engineering and related problems.

CLO06: Students must understand concept of Genetic Algorithm and its applications

Course Outcomes (COs)

CO01: Students will learn how Artificial Intelligence works in solving the common problems of daily life.

CO02: Students will be able to correlate the neural computing with working of human brain

CO03: Students will develop understanding of different types of neural networks and how to train them for problem solving in manufacturing.

CO04: Students will be able to develop and implement fuzzy logic for solutions for problems in manufacturing

CO05: Students will be able to develop and implement mini-expert systems for problems solving.

CO06: Students will be able to implement Genetic Algorithms for optimization problems in manufacturing

Unit-I

Introduction Definition and Terminologies, Basic concepts of artificial Intelligence, Scope, Role and potential of artificial intelligence in manufacturing, Declarative programming, Production Systems, Heuristics, Problem Characteristics. Search Techniques: Best first, Depth first & Breadth-first search, Branch and Bound, AND/OR graphs, Game Playing, General problem solver, Constraints satisfaction, Planning of tasks. Structured knowledge representation, knowledge representation issues, Predicate logic, Resolution, Representing knowledge using rules, Frame, Scripts, Conceptual dependency and Semantic nets. Application of knowledge based systems in design and manufacturing, Overview of advanced features, planning, learning, natural language processing, neural nets, fuzzy logic, object oriented programs.

Unit-II

Neural Computing: Structure and functioning of biological brain and neuron, concept of learning/training. Model of Artificial neuron, Transfer functions, ADALINE, MADALINE, Perceptron: Binary & Continuous inputs, linear seperability,

Unit-III

Perceptions: Single Layer and Multi-Layer Perceptron, Significance, Training using Back Propagation Algorithm & its derivation, Problems with Back Propagation. Hop-field Nets: Architecture, Energy functions, Training algorithms and examples. Application of NN in design, manufacturing and management

Unit-IV

Fuzzy Systems: Fuzzy Set Theory, Fuzzy complement, Union and Intersection. Fuzzy Logic: AND, OR, NOT operations, De-Morgan's Law, Membership functions, Fuzzy relations, Application of Fuzzy logic: Fuzzy control- selection of membership functions, Fuzzifications, Rule based design & Interfacing, defuzzification, Applications in Manufacturing and design.

Unit-V

Expert Systems: Overview of Expert systems, Concepts of ES, Characteristics of ES, The Development of ES Technology, Expert System applications and domain .Application of ES in Design, Manufacturing and Management architecture, comparison with procedural programming, developing Expert system for typical manufacturing domains, implementation and maintenance, state-of- art Expert system application, case study Domains welding, casting, forming, metal cutting, maintenance

Unit-VI

Genetic Algorithm: Robustness of Traditional Optimization and Search methods – Goals of optimization-GA versus Traditional methods, Mathematical foundations: The fundamental theorem - Schema processing at work. The 2-armed and k-armed Bandit problem.The building Block Hypothesis. GA OPERATORS, Data structures Reproduction- Roulettewheel Selection – Boltzman Selection – Tournament Selection-Rank Selection, Steady state selection, Crossover mutation, A time to reproduce, a time to cross. Get with the Main program. Mapping objective functions to fitness forum. Fitness scaling. Coding A Multi parameter, Mapped, Fixed point coding Discretization – constraints. Current Applications.

Text Books

1. David E. Gold Berg, "Genetic Algorithms in Search, Optimization & Machine Learning", Pearson , 2001
2. S.Rajasekaran, G.A.VijayalakshmiPai, " Neural Networks, Fuzzy Logic and Genetic Algorithms ", PHI ,
3. Kosko B. Neural Networks and Fuzzy Systems –PHI.
4. Aleksander& Morton, An Introduction to Neural Computing
5. Elaine Rich, Kevin Knight- Artificial Intelligence

Reference Books

1. Kalyanmoy Deb, "Optimization for Engineering Design, algorithms and examples", PHI 1995
2. Schalkoff, Artificial Intelligence: An Engineers Approach, McGraw Hill
3. Yoh-Han Pao Adaptive Pattern Recognition and Neural Networks Addison- Wesley

Subject Code	Subject Name	Hours per Week			Hours	Credits
		L	T	P		
ME5CA01	**Finite Element Method** (Common to All)	4	0	4	8	6

Course Learning Objectives (CLOs)

CLO01: Students must understand the concept of various methods of mathematical modelling of an engineering problems and Concept of Finite Element Method
CLO02: Students must be able to understand the concept of 1-D Finite Element Modelling
CLO03: Student must be able to understand the concept of 2-D Finite Element Modelling
CLO04: Students must be able to develop Finite Element Model of load bearing structures like trusses and frames.
CLO05: Students must be able understand the applications of Finite Element Method in different domains.

Course Outcomes (COs)

CO01: Students will be able to use suitable method to model the given problem and find solution thereof and basics of Finite Element Methods.
CO02: Students will be able to identify the boundary conditions and analyze structures by converting them in Finite Element Models using one-dimensional elements.
CO03: Students will be able to identify the boundary conditions and analyze structures by converting them in Finite Element Models using two-dimensional elements.
CO04: Students will be able to identify boundary conditions and analyze multi-element load carrying structures using Finite Element Modelling.
CO05: Students will be able to develop to analyze problems in domains like Fluid flow, Heat transfer and Vibrating bodies developing Finite Element Models.

Unit-I

Introduction to FEM, Mathematical Models and Approximations: History of FEM and applicability to mechanical engineering design problems: Review of elasticity. Mathematical models for structural problems: Equilibrium of continuum-Differential formulation, Energy Approach Integral formulation, Principle of Virtual work Variational formulation. Overview of approximate methods for the solution of the mathematical models, Residual methods and weighted residual methods, Ritz, Rayleigh-Ritz and Gelarkin's methods.Philosophy of solving continuum problems using Finite Element method.

Unit-II

Finite Element Formulation: Generalized FE formulation based on weighted residual methodand through minimization of potential, displacement based formulation, Concept of Discretization, Interpolation, Formulation of Finite element characteristic matrices and vectors, Compatibility conditions, Assembly and boundary considerations, Concept of Shape Functions.

Unit-III

FE Analysis for One Dimensional Structural problems: Structural problems with one dimensional geometry. Bar element: formulation of stiffness matrix, consistent and lumped load vectors. Boundary conditions and their incorporation: Elimination method, Penalty Method, Introduction to higher order elements and their advantages and disadvantages. Formulation for Truss elements, Case studies involving hand calculations with an emphasis on Assembly, boundary conditions, contact conditions and multipoint constraints. Beams and

Frames: Review of bending of beams, interpolation for beam elements and formulation of FE characteristics, Plane and space frames and examples problems involving hand calculations. Algorithmic approach for developing computer codes involving 1-D elements.

Unit-IV

FE analysis of Two dimensional Problems: Interpolation in two dimensions, natural coordinates, Isoparametric representation, Concept of Jacobian. Finite element formulation for plane stress plane strain and axi-symmetric, Fluid Flow problems; Triangular and Quadrilateral elements, higher order elements, subparametric, Isoparametric and superparametric elements. Formulation of plate bending elements using linear and higher order bending theories, Shell elements, General considerations in finite element analysis of design problems, Choosing an appropriate element and the solution strategies.
Introduction to pre and post processing of the results and analysis. Three Dimensional Problems: Finite element formulation for 3-D problems, mesh preparation, tetrahedral and hexahedral elements, case studies.

Unit-V

FEM in Heat Transfer and Fluid Mechanics problems: Finite element solution for one dimensional heat conduction with convective boundaries. Formulation of element characteristics and simple numerical problems.Formulation for 2-D and 3-D heat conduction problems with convective boundaries.Introduction to thermo-elastic contact problems. Finite element applications in potential flows; Formulation based on Potential function and stream function. Design case studies.

Dynamic Analysis: FE formulation in dynamic problems in structures using Lagragian Method, Consistent and lumped mass models, Formulation of dynamic equations of motion, Modelling of structural damping and formulation of damping matrices, Model analysis, Mode superposition methods and reduction techniques.

Text Books

1. Seshu P, Textbook of Finite Element Analysis, PHI. 2004
2. Reddy, J.N., Finite Element Method in Engineering, Tata McGraw Hill, 2007.
3. SingiresuS.Rao, Finite element Method in Engineering, 5ed, Elsevier, 2012
4. Zeincowicz, The Finite Element Method 4 Vol set, 4th Edition, Elsevier 2007.
5. Alavala C.R., Finite Element Methods, PHI, 2009.
6. Moaveni S. PHI, 2009

List of Experiments:

1. Introduction to Finite Element Analysis
2. Introduction to FEA package
3. Analysis of a truss
4. Stress analysis of beams
5. Stress analysis of a plate with circular hole
6. Analysis of a corner bracket
7. Model analysis of a cantilever beam
8. Harmonic analysis of simple systems
9. Conductive heat transfer analysis of a 2D Component

Subject Code	Subject Name	Hours per Week			Hours	Credits
		L	T	P		
ME5EL12	**Metal Forming and joining process** (Elective-II)	4	0	0	4	4

Course Learning Objectives (CLOs)

CLO01: Students must have basic understanding of mechatronic systems and their applications.
CLO02: Students must be able to understand the principles of different sensors and actuators to be used in mechatronic system
CLO03: Students must understand the basic concepts of analog and digital signals generated from mechatronic systems.
CLO04: Students must be able to develop the basic understanding of various components of mechatronic model of a system.
CLO05: Students must understand the design, programming and working of some basic micro-processors, microcontrollers and programmable logic controllers and the functioning of the electronic components used inside them.

Course Outcomes (COs)

CO01: Students will be able to model mechatronic systems for the given applications.
CO02: Students will be to select appropriate sensor and actuators for a particular application.
CO03: Students will be able to apply the concepts processing of analog and digital signals in designing of mechatronic system.
CO04: Students will be able to design and check the performance of different systems mechanical, electrical and electronic systems.
CO05: Students will be able to select and program micro-processors, micro-controllers and PLCs for the given application.

Unit-I

Introduction & basic materials used in foundry:
Definition, Classification of manufacturing processes. Metals cast in the foundry-classification, factors that determine the selection of a casting alloy. Introduction to casting process & steps involved.
Patterns: Definition, classification, materials used for pattern, various pattern allowances and their importance.
Sand moulding: Types of base sand, requirement of base sand. Binder, Additive's definition, need and types; preparation of sand moulds. Molding machines- Jolt type, squeeze type and Sand slinger.
Study of important moulding process: Green sand, core sand, dry sand, sweep mould, CO2mould, shell mould, investment mould, plaster mould, cement bonded mould. Cores: Definition, need, types. Method of making cores, Concept of gating (top, bottom, parting line, horn gate) and risers (open, blind) Functions and types.

Unit II

Melting furnaces: Classification of furnaces, Gas fired pit furnace, Resistance furnace, Coreless induction furnace, electric arc furnace, constructional features & working principle of cupola furnace.

Casting using metal moulds: Gravity die casting, pressure die casting, centrifugal casting, squeeze casting, slush casting, thixocasting, and continuous casting processes. Casting defects, their causes and remedies.

Unit III

METAL FORMING PROCESSES: Introduction of metal forming process: Mechanical behavior of metals in elastic and plastic deformation, stress-strain relationships, Yield criteria, Application to tensile testing, train rate and temperature in metal working; Hot deformation, Cold working and annealing.

Metal Working Processes: Fundamentals of metal working, Analysis of bulk forming processes like forging, rolling, extrusion, wire drawing by slab method,**Other sheet metal processes:** Sheet metal forming processes (Die and punch assembly, Blanking, piercing, bending etc., Compound and Progressive die), High Energy rate forming processes.

Unit IV

JOINING PROCESSES

Fusion welding processes: Gas welding - Types – Flame characteristics; Manual metal arc welding – Gas Tungsten arc welding - Gas metal arc welding – Submerged arc welding.

Unit V

Weldability and thermal aspects:

Concept of weldability of materials; Thermal Effects in Welding (Distortion, shrinkage and residual stresses in welded structures); Welding defects and remedies.**Allied processes:**Soldering, Brazing and adhesive bonding. **Advance welding processes:**Resistance welding processes, friction stir welding (FSW).

Text Books:

1. Ghosh, A. and Mallik, A. K., (2017), Manufacturing Science, East-West Press.
2. Parmar R. S., (2007), Welding Processes and Technology, Khanna Publishers.
3. Little R. L. – 'Welding and Welding Technology' – Tata McGraw Hill Publishing Company Limited, New Delhi – 1989
4. Grong O. – 'Metallurgical Modelling of Welding' – The Institute of Materials – 1997 – 2nd Edition
5. Kou S. – 'Welding Metallurgy' – John Wiley Publications, New York – 2003 – 2nd Edition

Reference Books:

1. SeropeKalpakjian and Steven R. Schmid – 'Manufacturing Engineering and Technology' – Prentice Hall – 2013 – 7th Edition
2. Principles of foundry technology, 4th edition, P L Jain, Tata McGraw Hill, 2006.
3. Advanced Welding Processes technology and process control, John Norrish, Wood Head Publishing, 2006

Subject Code	Subject Name	Hours per Week			Hours	Credits
		L	**T**	**P**		
ME5PC04	**Minor Project-II**	0	0	16	16	8

Students should model, analyze and animate /fabricate a functional model of any component, sub system or a mechanism used in automobile. They should prepare a mini project report and submit it.

SEMESTER – III

Sr. No.	Course Code	Course Name	L	T	P	Hours	Credits
1	ME5CM05	Metallurgical Thermodynamics	4	0	4	8	4
2	ME5EL13	Elective III: Metrology and Inspection	4	0	0	4	6
3	EN5HS02	Technical Paper writing	0	0	2	2	1
4	EN5MC01	Value and Ethics	2	0	0	2	0
5	ME5PC05	Dissertation Phase-I	0	0	20	20	10
		Total	**10**	**0**	**6**	**36**	**21**

Subject Code	Subject Name	Hours per Week			Hours	Credits
		L	T	P		
ME5CM05	Metallurgical Thermodynamics	4	0	4	8	4

Course Learning Objectives (CLOs):

CLO01: To learn Fundamentals of Materials Thermochemistry
CLO02: Ability to solve problems on different Metallurgical systems.
CLO03: Learn principles of solution Thermodynamics and its application to Industrial solutions.
CLO04: Identify and solve reaction kinetics and mechanism.
CLO05: Ability to correlate electrochemistry with thermodynamic Parameters

Course Outcomes (COs):
After completion of this course the students shall be able to:

CO01: Practise the laws of thermodynamics in combustion reactions.
CO02: Analyze the systems from the viewpoint of free energy and entropy.
CO03: Apply the phase rule on the metallurgical systems.
CO04: Calculate thermodynamic quantities of solutions.
CO05: Analyze the relationship between molar ratio - free energy – activity.

Unit-I
Introduction: Definitions, behaviour of gasses, vapours and gaseous moisture, materials balances in metallurgical processes. First law of thermodynamics, Heat and work changes in reversible processes, Concept of Heat Capacity, Enthalpy energy balance in metallurgical processes, Reversible adiabatic process.

Unit-II
Entropy: The Carnot cycle, concept of entropy, Entropy changes in reversible, irreversible processes and universe, Clausius inequality, combined statement of first and second law, Entropy change for irreversible chemical reactions. Helmholtz free energy and the Gibbs free energy, free-energy equations in differential form, Thermodynamic potentials, The Maxwell relations, Criteria of equilibrium and spontaneity (or irreversibility), The Gibbs-Helmholtz equation.

Unit-III

Chemical Potential: Concept of chemical potential, Chemical potential of oxygen, partial molar quantities, Integral molar quantities, Raoult's law and Henry's law, Alternative standard states, Sievert's law, Mixing function, Excess function, Regular solution, concept of interaction parameter.

Unit-IV

Free Energy: Fugacity, Activity, standard state, equilibrium constant, Van't Hoff reaction isotherm,Le Chatelier's Principle, Free-energy Charts and Ellingham diagrams, Gas-solid reaction, Van't Hoff equation, Sigma Function (Σ), Clausius-Clapeyron Equation, Trouton's Rule.

Unit-V

Electrochemical Cell: Types of electrochemical cells, Laws of electrolysis, determination of thermodynamics quantities using reversible electrochemical cells, Electrochemical cell based on solid electrolytes, Types of reaction, Order of reaction, Determination of order and rate constant of a reaction.

Text Books:

1. Introduction to Metallurgical Thermodynamics – David R Gaskell.
2. Metallurgical Thermochemistry – O. Kubaschewski, E LL Evans and C B Alcock

References:

1. Stoichiometry and thermodynamics of Metallurgical processes - Y K Rao.
2. Problems in Metallurgical Thermodynamics and Kinetics – G S Upadhyay and R K Dube.
3. Chemical Kinetics - Keith Laidler.

List of Experiments:

1. Introduction to Thermodynamic Terms and Properties
2. Introduction to Thermodynamic Processes
3. To calculate the Heat of Vaporisation (Hv) of a liquid (e.g. Water) by using CLAUSIUS –CLAPEYRON Equation
4. To compare the diffusivity of Gases, Liquid, and Solid by experimentally determined values of their respective Diffusion Coefficients
5. To determine an average value of heat transfer coefficient under different fluid flow conditions.
6. To determine the standard free energy, enthalpy and entropy of formation of calcium carbonate through pressure measurement technique
7. To study the Kinetics of oxidation of copper in atmospheric air by the weight gain method.
8. (a) To determine the decomposition voltage of aqueous solutions of ZnSO4. (b)To determine current efficiency by using aqueous solution of CuSO4.

Subject Code	Subject Name	Hours per Week			Hours	Credits
		L	T	P		
ME5EL13	**Metrology and Inspection** (Elective III)	4	0	0	4	4

Course Learning Objectives (CLOs)
CLO01: To describe the concept of metrology.
CLO02: To explain about metrology instruments and application for various measurements.
CLO03: To discuss the concept of computer applications in metrology.
CLO04: To acquire the principles of various Inspection, Instruments and Methodology.
CLO05: To develop the knowledge in the area of non-contact inspection.

Course Outcomes (COs)
CO01: Students will be able todescribe the scope, outcomes, evolution and basics of different types of metrology including surface metrology.
CO02: Students will be to describe the standards for length measurement and perform their calibration.
CO03: Students will be able to describe and compare various angular measurement instruments and their working principles.
CO04: Students will be able to explainprinciples of computer aided metrology.
CO05: Students will be able to explain working principle and compare various advanced measurement techniques.

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

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

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

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

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

Text Books

1. Fundamentals of dimensional Metrology T. Busch and R. Harlow Delmar, 3e
2. Engineering Metrology G. Thomas and G. Butter Worth PUB
3. Sensors and Control systems in Manufacturing Sabne Solomon McGraw Hill Book
4. Measurement systems: Applications & Design Doebelin International Student Edition

Reference Books

1. Optoelectronics for Technology and Engineering Robert G. Seippel Prentice Hall India
2. Interface Technology for Computer Controlled Ulrich-Rembold, Armbruster Marcel Dekker Publications, Manufacturing processes and Ulzmann NY
3. Study manual on tolerance stacks, vol.1 Second edition ASME. 1994
4.Dimensioning and tolerancing of mass Spotts Prentice Hall, 1983

Subject Code	Subject Name	Hours per Week			Hours	Credits
		L	**T**	**P**		
EN5HS02	**Technical Paper Writing**	0	0	2	2	1

- Report writing, various formats
- Plagiarism
- How to make a synopsis
- Reading techniques
- Making a hypothesis
- Writing abstract and Summary
- Paraphrasing
- Building thoughts
- Chapterization
- Formatting
- Oral presentation
- How to make good ppts
- Viva voce/ interviews
- Importance of syntax and semantics, Mechanics of writing, Proof reading

Text Books:

1. C.R Kothari. Research Methodology. Sultan Chand & Sons, New Delhi.
2. Day R A. How to Write and Publish a Scientific Paper. Cambridge University Press.
3. Sharma RC and Krishna Mohan, Business correspondence and report writing, Tata Mc Graw Hill.
4. Murphy Herta A, Herberrt W Hildebrandt, Jane P Thomas. Effective Business Communication. Tata Mc Graw Hill.
5. Rizvi Ashraf. Effective Technical Communication. Tata Mc Graw Hill.
6. KoneruAruna. Professional Communication, McGraw Hill

Subject Code	Subject Name	Hours per Week			Hours	Credits
		L	T	P		
EN5MC01	Values & Ethics	2	0	0	2	0

Unit-I
Human Values
Morals, Values and Ethics, Integrity, Work Ethic, Honesty, Courage, Empathy , Self-Confidence , Character.

Unit-II
Engineering Ethics
Senses of Engineering Ethics, variety of moral issued, types of inquiry, moral dilemmas, moral autonomy, Kohlberg's theory, Gilligan's theory, consensus and controversy, Models of Professional Roles, theories about right action, Self-interest, customs and religion, uses of ethical theories, Valuing Time, Co-operation, Commitment.

Unit-III
Engineering As Social Experimentation
Engineering as experimentation, engineers as responsible experimenters, codes of ethics, a balanced outlook on law, the challenger case study

Unit-IV
Safety Responsibilities and Rights
Safety and risk, assessment of safety and risk, risk benefit analysis and reducing risk, the three mile island and Chernobyl case studies.

Unit-V
Global Issues
Multinational corporations, Environmental ethics, computer ethics, weapons development, engineers as managers, consulting engineers, engineers as expert witnesses and advisors, moral leadership.

Text Books

1. Mike Martin and Roland Schinzinger, “Ethics in Engineering”, McGraw-Hill, NewYork 1996.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, “Engineering Ethics”, PrenticeHall of India, New Delhi, 2004.

Reference Books

1. Charles D. Fleddermann, “Engineering Ethics”, Pearson Education / Prentice Hall, New Jersey, 2004 (Indian Reprint now available).

2. Charles E Harris, Michael S. Protchard and Michael J Rabins, “Engineering Ethics – Concepts and Cases”, Wadsworth Thompson Leatning, United States, 2000 (India Reprint now available)
3. John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, NewDelhi, 2003.
4. Edmund G Seebauer and Robert L Barry, “Fundamentals of Ethics for Scientists andEngineers”, Oxford University Press, Oxford, 2001.

Subject Code	Subject Name	Hours per Week			Hours	Credits
		L	**T**	**P**		
ME5PC05	**Dissertation Phase-I**	0	0	0	20	10

Students should model, analyze and animate /fabricate a functional model of any component, sub system or a mechanism used in automobile. They should prepare a thesis report and submit it.

SEMESTER-IV

Sr. No	Course Code	Courses	L	T	P	Hrs.	Credits
1	ME5CM06	Advanced Machining Processes and Tool Design	4	0	4	8	6
2	EN5HS01	Entrepreneurship and Management	3	0	0	3	3
3	ME5PC06	Dissertation Phase-II	0	0	32	32	16
Total			**7**	**0**	**4**	**43**	**25**

Subject Code	Subject Name	Hours per Week			Hours	Credits
		L	T	P		
ME5CM06	**Advanced Machining Process and Tool Design**	4	0	4	8	6

Course Learning Objectives (CLOs)

CLO01: Students must know the limitations of conventional machining processes and features of Mechanical type advanced processes.

CLO02: Students must understand the working principles of different types of Thermo-Electric Machining processes.

CLO03: Students must understand the working principle of Chemical and Electro-Chemical Machining.

CLO04: Students must understand the detailed process of tool design.

CLO05: Students must be able to design different types of tools for heavy machining processes.

Course Outcomes (COs)

CO01: Students will learn the intricacies of different mechanical type processes, the process parameters and select a appropriate process for a particular application.

CO02: Students will learn the intricacies of different thermo-electric type processes, the process parameters and select a appropriate process for a particular application.

CO03: Student will be able to distinguish and select Chemical and Electro-Chemical Machining for a particular application.

CO04: Students will able to design the tools for larger tool life.

CO05: Students will be able to design different types of tools for heavy machining processes.

Unit I

Introduction: Limitations of Conventional machining processes, Need of advanced machining processes, Classification of advanced machining processes, Considerations in the process selection. **Mechanical Type Processes** : FundamentalPrinciple, Process description, Process Capabilities, Effects of process parameters on MRR, accuracy and surface finish, Mechanics of Material Removal, Parametric Analysis, Tool Design, Applications and Limitations of Abrasive Jet Machining (AJM), Ultrasonic Machining (USM), Water Jet Machining (WJM).

Unit II

Thermo-Electric Type Processes: FundamentalPrinciple, Process description, Process Capabilities, Effects of process parameters on MRR, accuracy and surface finish, Mechanics of material removal, Parametric Analysis, Tool Design, Applications and Limitations of-Electrical Discharge Machining (EDM), Wire EDM (WEDM), Electron Beam Machining (EBM), Laser Beam Machining (LBM), Plasma Arc Machining (PAM)

Unit III

Chemical and Electrochemical Type Processes: FundamentalPrinciple, Process description, Process Capabilities, Effects of process parameters on MRR, accuracy and surface finish, Mechanics of material removal, Parametric Analysis, Tool Design, Applications and Limitations of- Chemical Machining (CM) Processes, Electrochemical Machining (ECM), Electrochemical Honing andElectrochemical de-burring (ECD)

Unit IV

Design of Jigs: Introduction – Location Principles – Six Point Location Principle – Locators – Clamping Principles – Clamping Devices – Drill Jigs – Drill Bushes – Drill Jig Types – Design and Development of Jigs for given components.

Design of Fixtures: Milling Fixtures – Milling Methods – Milling Fixture Types – Turning fixtures – Broaching Fixtures – Grinding Fixtures – Assembly, Inspection and Welding Fixtures – Modular Fixtures – Design and Development of Fixtures for given components.

Unit V

Design of Dies: Power presses types and construction details, die cutting operation, cutting action in die and punch, center of pressure, clearance and its significance, cutting forces, methods of reducing cutting forces, methods of punch support, strippers, stock stops, guide pilots, knockout, design of blanking and piercing dies. Design Concepts and description of the components of progressive dies. Design of progressive dies. Design of compound dies. Design of combination dies

Text Books:

1. P. C. Pandey and H. S. Shan, Modern Machining Processes, Tata McgrawHill,New Delhi, 2003.
2. P. K. Mishra, Nonconventional machining, Narosa publishing house, 2011
3. P. H. Joshi – 'Jigs and Fixtures Design Manual' – McGraw Hill – 2002
4. Kempster M. H. A. – 'An Introduction to Jig and Tool Design' – Viva Books Pvt. Ltd. – 2002
5.Paquin and Crowley – 'Die Design Fundamentals' – Industrial Press, New York – 1979

References:

1. V. K. Jain, Advanced Machining processes, Allied publishers, New Delhi, 2008.
2. G. Benedict, Non-traditional manufacturing processes, Marcel Dekker, New York, 1st Edition, 1987.
3. E. K. Henriksen – 'Jig and Fixture Design Manual' – Industrial Press, New York – 1973
4. Donaldson, Lecain and Goold – 'Tool Design' – McGraw Hill, New York – 1976

List of Experiments

1 Pattern design and making –for one casting drawing.
2 Sand properties testing exercise for strengths and permeability
3 Moulding melting and casting.

4 Arc welding lap & butt joint
5Spot welding
7 Plasma welding and Brazing (Water plasma device).
8 Study of general requirement of machine tool design.
9. Study of working and auxiliary motion of machine tool.
10. Design criterion for machine tool structure, Static & dynamic stiffness.
11. Function & important requirements of spindle unit.
12. Importance of machine tool compliance with respect to machine tool.

Subject Code	Subject Name	Hours per Week			Hours	Credits
		L	T	P		
EN5HS01	**Entrepreneurship and Management**	3	0	0	3	3

Unit-I: Introduction to Entrepreneurship

Definition and Meaning, Concept and Need of Entrepreneurship; Role of entrepreneurship in Economic Development; Factor Affecting Entrepreneurial Growth – Economic, Non-Economic Factors, Managerial vs. entrepreneurial approach, Entrepreneur vs. Intrapreneur, Types of Entrepreneurs, Traits/Qualities of an Entrepreneurs, Characteristic of successful entrepreneurs, Entrepreneurship process, Women as Entrepreneurs, Ethics and Social Responsibilities; Entrepreneurial challenges.

Unit-II: Creating and Starting the Venture Business plan

Meaning, Significance, contents, formulation and presentation of Business Plan, implementing business plans. Marketing plan, financial plan and the organizational plan, Launching Formalities, Common errors in Business Plan formulation.

Unit: III- Innovation and Entrepreneurship

Entrepreneurship and Innovation. The Innovation Concept, Importance of Innovation for Entrepreneurship, Source of Innovation for Opportunities, The Innovation Process, Product life cycle, new product development process, Creativity and innovation in product modification/ development.

Unit-IV-Introduction to Management and Organization

Concept and differences between industry, commerce and business. Various types of ownership in the organization– Definition, Characteristics, Merits & Demerits, Single ownership, Partnership, Cooperative Organizations, Joint Stock Companies, Government owned. Difference between management and administration. Management as a science and as an art, different types of leadership models-Autocratic Leader, Democratic Leader, Free Rein Leader, Freelance Leader.

Unit-V–Functions of Management Planning

Definition, Types of Planning, Steps in planning process. Nature and Purpose of Organizing: Staffing, Line and Staff Relationship, Line-Staff Conflict, Directing: definition and importance, Controlling: Concept and Process of Control, Control Techniques, Control as a Feedback System.

Text Books

1. Rajeev Roy, Entrepreneurship, Oxford University press.
2. Stephen P. Robbins, David A. Decenzo, Sanghmitra Bhattacharya, Madhushree Nanda Agarwal, Fundamentals of Management, Pearson Education.
3. Robbins, Management, Pearson Education.
4. Harold Koontz, O'Donnell, Heinz Weihrich, Essentials of Management. Tata McGraw Hill.
5. Stoner, Management, PHI Learning.
6. Vasant Desai, Small scale Industries and Entrepreneurship, Himalaya Publishing House.
7. Gupta C.B. Khanks S.S., Entrepreneurship and Small Business Management, Sultan Chand & Sons, New Delhi.

References

1. Greene, Entrepreneurship, Cengage learning.
2. B. K. Mohanty Fundamentals of Entrepreneurship PHI.
3. Barringer, Entrepreneurship Pearson education.
4. Desai Vasant, Dynamics of Entrepreneurship Development and Management, Himalaya Publishing House
5. David H Holt Entrepreneurship: New Venture Creation, PHI.
6. Satyaraju, Parthsarthy, Management Text and Cases, PHI Learning.
7. Kanishka Bedi, Management and Entrepreneurship, Oxford Higher Education.

Subject Code	Subject Name	Hours per Week			Hours	Credits
		L	**T**	**P**		
ME5PC06	**Dissertation Phase-II**	0	0	0	32	16

Students should model, analyze and animate /fabricate a functional model of any component, sub system or a mechanism used in automobile. They should prepare a thesis report and submit it.