Department of Mechanical Engineering

CURRICULUM AND SYLLABUS

(2023-2027)

M. Tech. (Executive) in CAD/CAM/CAE

Medi-Caps University
Faculty of Engineering
Syllabus for Master of Technology (Executive) in CAD/CAM/CAE

Department of Mechanical Engineering

M. Tech. (Executive) in CAD/CAM/CAE

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 practical problems.

PEO-2 To develop research acumen for designing a system with better efficiency and performance.

PEO-3 To prepare students as experts with better communication skills, professional ethics and 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 mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineeringproblems.

PO02 **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO03 **Design/development of solutions**: Design solutions for complex engineering problems anddesign system components or processes that meet the specified needs with appropriate consideration for public health and safety, and the cultural, societal, and environmental considerations.

PO04 **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO05 **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO06 **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO07 **Environment and sustainability**: Understand the impact of professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO08 **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.

PO09 **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11 **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principlesand apply these to one's own work, as a memberand leader in a team, to manage projects and in multidisciplinary environments.

PO12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Department of Mechanical Engineering

PROGRAMME SPECIFIC OUTCOMES (PSOs)

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

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

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

PSO 4: Apply the research-based knowledge and research methods including design of 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	ME5CC02	Computer Integrated Manufacturing	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	ME5EL31	Elective I: Artificial Intelligence in Manufacturing	4	0	0	4
2	ME5CA01	Finite Element Methods	4	0	4	6
3	ME5EL32	Elective II: Mechatronics	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	ME5CC05	Robotics	4	0	4	6
2	ME5EL33	Elective III: Precision Engineering	4	0	0	4
3	EN5HS02	Technical Paper writing	0	0	2	1
	EN5MC01	Value and Ethics	2	0	0	2
4	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	ME5CC06	Advanced Machining Processes	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**

Medi-Caps University
Faculty of Engineering
Syllabus for Master of Technology (Executive) in CAD/CAM/CAE

SEMESTER – I

Sr. No.	Course Code	Course Name	L	T	P	Hours	Credits
1	ME5BS01	Mathematics	4	0	0	4	4
2	ME5CC02	Computer Integrated Manufacturing	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		
ME5CC02	**Computer Integrated Manufacturing**	4	0	4	8	6

Course Learning Objectives (CLOs):

CLO01: To develop an ability to apply knowledge of fundamentals of Production system to modern manufacturing organisation.
CLO02: To understand the Computer Aided Design and to study various ways of employing computer in different aspect of engineering design.
CLO 03: To understand various Computer Aided Process Planning concepts.
CLO 04: To apply NC, CNC machine and its part programming fundamentals to crate part programming for various products
CLO 05: To evaluate the need, advantages and application of Computer Aided Quality Control and Automated Material Handling Systems.

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

CO01: Understand Manufacturing and CIM Concept, CAD, Computer Aided Process Planning.
CO02: Understand Numeric control technique and Part programming fundamentals, Computer Aided Quality Control and Automated Material Handling Systems.
CO03: Analyze the part drawing for CNC Part programming.
CO04: Apply the concept of Part Programming fundamental to generate the Part Program for various machining operations.
CO05: Create work part on CNC machine by Part programming concepts.

Unit-I

Computer Integrated manufacturing System: Definition, Concept of CIM wheel, Evolution of CIM, Automation and reasons of automation, System view of manufacturing, Concurrent Engineering, Elements of CIM system, CIM hardware and software.

Unit-II

Computer Aided Design: Historical background, Development of CAD, CAD System, CAD Software: Different Graphics standards, Basic definitions, Modes of graphic operation, User interface, Software modules, Modeling and viewing, 2D scaling- Representation and transformation of Points, transformation of Lines –Rotation, Reflection, Scaling and combined transformations, 3Dscaling-shearing, Rotation, Reflection, Translation - Projections parametric representation of Ellipse, Parabola, Hyperbola, CAD Hardware: Input devices, output devices, concept of workstations and its types, Types of Modelling: Wire frame, Surface and Solid modeling –Different Solid modeling packages.

Unit-III

Computer Aided Process Planning: Computer Aided Process Planning - Retrieval and Generative approaches, Feature Identification- Algorithms, Graph Based Approach, Attribute Adjacency Graph, Benefits of CAPP.

Unit-IV

Computer Aided Manufacturing and Manufacturing Systems: CNC technology and its evelopment, Classification of CNC Machine Tools, Concepts of DNC, CNC Controller, its types, Part Programming of Prismatic and revolved components, APT part programming using CAD, CAM S/w. Group Technology: Concept of part family, parts classification and coding and Production Flow Analysis, Cellular Manufacturing and introduction to Flexible Mfg. system.

Unit-V

Computer Aided Quality Control: Overview of Automated Identification Methods, Bar Code Technology, Radio Frequency Identification, Other ADC Technologies- Magnetic Stripes, Optical Character Recognition, and Machine Vision.

Unit-VI

Automated Material Handling Systems: Overview of handling system, Design considerations and principles of Material Handling, Material Transport Equipment-Industrial Trucks, Automated Guided Vehicles, Monorails and Other Rail-Guided Vehicles, Conveyors, Cranes and Hoists, **Automated Storage/Retrieval Systems** : Storage Location Strategies, Engineering Analysis of AS/RS

Reference Books:

1. Groover, Production System & CIM: PHI
2. Zeid, CAD/CAM Theory & Practice: McGraw Hills
3.Nanua Singh, Approach to computer integrated design and manufacturing :- ,John Wiley and sons
4.James Madison. "CNC Machining Hand Book ". Industrial Press Inc.. 1996.
5.Radhakrishnan. P. "Computer Numerical Control Machines ". New Central Book Ag
6.Tien-Chien Chang, Richard A. Wysk, "An Introduction to automated process planning systems ",Prentice Hall, 1985.
7. Rao P.N., "Computer Aided Manufacturing ", Tata McGraw Hill Publishing Co., 2000

List of Experiments

1. Modeling and Simulation of Computer Integrated Manufacturing System
2 Modelling, Offline Manual Part Programming and Simulation of the operation of a 3 axis CNC Milling Machine
3 Programming and operation of a 3 axis CNC Milling Machine
4 CAD/CAM based Part Programming and operation of a 3 axis CNC Milling Machine
5 Modelling, offline programming and simulation of a 5-Axis Robot manipulator 6 Programming and operation of a 5-Axis Robot manipulator
7 Machine vision based quality control
8 Remote Monitoring and Operation of a Computer Integrated Manufacturing System
Use of software for simulation of turned and milled parts and simple surfaces, Automatic Cutter location data generation from CAD Models in APT format and post-processing for machining on CNC machines using standard CAD/CAM software.
9 Simulation inspection planning for automated inspection for an automotive component

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	ME5EL31	Elective I: Artificial Intelligence in Manufacturing	4	0	0	4	4
2	ME5CA01	Finite Element Methods	4	0	4	8	6
3	ME5EL32	Elective II: Mechatronics	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		
ME5EL31	**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

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

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

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		
ME5EL32	**Mechatronics** (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 to Mechatronics: Definitions of mechatronics, Concept of system, Block diagram of Mechatronic system, Functions of Mechatronics Systems, Measurement systems and Controlling systems, Modelling of Systems, Benefits of mechatronics in manufacturing. Applications. Different mechatronic systems.

Unit II

Sensors Transducers and Actuators :Difference between Sensor and Transducer, Review of different sensors : Displacement, Position and Proximity sensors,Velocity and Motion sensors, Force, Fluid Pressure,Liquid flow and Level sensors, Temperature sensors ,Torque,Light Sensors, Vibration Sensors and Smart Sensors. Performance terminology of sensors, Static and Dynamic characteristics of sensors. Mechanical Actuation Systems – Kinematic chains, Cams, Gears, Richet and Pawl, Belt and Chain Drives, Electrical Actuation Systems –Mechanical Switches, Solid State Switches, Solenoids, DC and AC motors, Stepper

Motors, Servo motor, Thyristors, Triacs, Hydraulic and Pneumatic Actuators, Piezoelectric actuators.

Unit III

Analog and Digital Signal Conditioning: Difference between Analog and Digital signals, *Analog Signal Processing*: Operational amplifier and its ideal model, Different types of OP amplifiers, Protection, Filtering, Wheatstone bridge, Pulse Modulation,*Digital Signal Processing:* Digital signal, Conversion of Analog and Digital signals and vice versa, Multiplexers, Data acquisition : Quantization theory,Boolean algebra to represent Digital logic, Logic gates and its types, application of logic gates, Combinational and Sequential logic. Flip flops and its applications, Counters and Timers.

Unit IV

System Models : Mathematical models, Building blocks for – Mechanical Systems, Electrical Systems, Fluid systems and Thermal systems, Engineering – Rotational Translation system, Electromechanical systems, Hydraulic Mechanical systems, Modelling dynamic systems and measuring response of first and second order systems,Transfer function and Frequency responsefor- first order, second order, systems with feedback loops frequency response, bode plots,performance specifications,stability,Closed loop controllers. Integrated Circuit System Design – Example of Digital tachometer.

Unit V

Microprocessors, Microcontrollers and Programmable Logic Controllers: Microprocessor- Architecture of Intel 8085, Different types of registers, programming of Intel 8085, Microcontroller architecture of Intel 8051, Selecting a microcontroller and its applications. Programmable Logic Controllers (PLCs): Architecture, Different programming methods, Basics of Ladder logic Programming, Logics, Timers and Counters, Shift registers, Application on real time industrial automation systems.

Text Books:

1. W. Bolton, Mechatronics, Electronic control systems in mechanical and electrical engineering, Pearson Education, 5/e, 2011.
2. David G. Alcaiatore and Michel B. Histand, Introduction to Mechatronics and Measuring Systems, Mc. Graw Hill Int. Edition, 3/e, 2006.
3. NitaigourPremchandMahalik, Mechatronics-*Principles,Concepts,Applications,* Tata McGraw Hill.
4. K.P. Ramchandran, G.K. Vijayraghvan, M.S. Balasundram, Mechatronics-*Integrated mechanical Electronics Systems,* Wiley India Pvt. Ltd. ,Istedition, 2008

Reference Books:

1. Mechatronics-Integrated technologies for intelligent machines, Oxford University Press, Ist Edition, 2008.

2. Robert H. Bishop. The Mechatronics Handbook, CRC Press, 2/e, 2007.
3. Craig K. C. and Stolfi, F. R., Introduction to Mechatronic System Design with Applications, IEEE Educational Activities Department, 1994.

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	ME5CC05	Robotics	4	0	4	8	4
2	ME5EL33	Elective III: Precision Engineering	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		
ME5CC05	**Robotics**	4	0	4	8	4

Course Learning Objectives (CLOs):

CLO01: To introduce the functional elements of Robotics.
CLO02: To impart knowledge on the direct and inverse kinematics.
CLO03: To introduce the dynamics and control of manipulators.
CLO04: To impart knowledge on the sensors and end effectors working.
CLO05: To introduce about robot programming and programming language.

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

CO01: Understand basics of robotics, robot programming sensor types.
CO02: Apply the knowledge for selection of sensor and gripper as per requirement.
CO03: Analyse the kinematic and dynamic behaviour of a manipulator and gripper.
CO04: Apply the knowledge of robot end effectors and sensors in the real world.
CO05: Apply the knowledge of robot programming and languages in the real world.

Unit-I

Introduction: Definitions, Laws of Robotics, Historical Development, Classification of Robots, Robot Anatomy, Robot Manipulator, Basic Robot Configurations and their Relative Merits and Demerits, the Wrist & Gripper Subassemblies, Work Volume, Concepts about Basic Drive & Control Systems, Robot Accuracy & Repeatability, End Effectors, Sensors, Robot Applications.

Unit-II

Kinematics of Robot Manipulator: Introduction, Direct Kinematics problem, Rotation matrix, Composite Rotation matrix, Homogenous Transformations, Robotic Manipulator Joint Co-Ordinate System, Euler Angle & Euler Transformations, D-H Representation & Displacement Matrices for Standard Configurations, Inverse Kinematics problems.

Unit-III

Dynamics of Robotic Manipulators: Introduction,. Preliminary Definitions, Generalized Robotic Coordinates, Jacobian for a Two link Manipulator, Euler Equations, Lagrangian Equations of motion, Lagrange–Euler Formulation of Robotic Manipulators, Lagrange–Euler Formulation of Robotic Manipulators, Newton–Euler Formulation of Robotic Manipulators, D'Alembert Equations.

Unit-IV

Robot End Effectors & Sensors: Introduction, Types of End Effectors, Mechanical Grippers, Other types of Grippers, Tools as End Effectors, Considerations in Gripper Selection & Design, Transducers & Sensors, Types of Sensors, Tactile, Proximity, Range & Miscellaneous Sensors.

Unit-V

Robot Programming & Languages: Introduction, Methods of Robot Programming, Leadthrough Programming Methods, Motion Interpolation, Wait, Signal & Delay Commands, Branching, Textual Robot Languages, Robot Language Structure, Motion Commands, End Effector Commands, Sensor Commands, Program Control & Subroutines.

Text Books:

1. Robotics, control vision and intelligence-Fu, Lee and Gonzalez. McGraw Hill International, 2nd edition, 2007.
2. Introduction to Robotics- John J. Craig, Addison Wesley Publishing, 3rd edition, 2010.
3. Industrial Robotics-Groover, Weiss, Nagel, McGraw Hill International, 2nd edition, 2012.
4. Introduction to Robotics, S K Saha, Tata McGraw-Hill.

References:

1. Robotics for Engineers -YoramKoren, McGraw Hill International, 1st edition, 1985.
2. Robotic Engineering - An Integrated approach, Klafter, Chmielewski and Negin, PHI, 1st edition, 2009.
3. Introduction to Robotics: Analysis, Control, Applications ,SaeedNiku, John Wiley & Sons.
4. Robotics and control, R K Mittal, I J Nagrath, Tata McGraw Hill 2003.

List of Experiments:

1. Study of robot components and its parameters.
2. Inverse kinematics of the real robot and validation using any software.
3. Use of open source computer vision programming tool openCV.
4. Image processing using openCV.
5. Image processing for colour/shape detection.
6. Positioning and orientation of robot arm.
7. Control experiment using available hardware or software.
8. Integration of assorted sensors (IR, Potentiometers, Strain gauges etc.) Microcontrollers and ROS (Robot Operating System) in a robotic system.

Subject Code	Subject Name	Hours per Week			Hours	Credits
		L	**T**	**P**		
ME5EL33	**Precision Engineering** (Elective III)	4	0	0	4	4

Course Learning Objectives (CLOs)

CLO01: Students must have basic understanding of design, development and optimization of manufacturing and measurement systems according to principles of precision engineering.
CLO02: Students must be able to perform the design, manufacture and measurement of products with special characteristics.
CLO03: Students must understand the basic concepts of additive manufacturing and rapid prototyping. Prototyping phases, workflow and integration into the product development cycle.
CLO04: Students must be able to develop the fast prototyping Technologies and system selection. Software and file formats.
CLO05: Students must understand the prototyping applications in industrial, medical, artistic and heritage conservation.

Course Outcomes (COs)

CO01: Students will be able to explain in his/her own words and distinguish the meanings of accuracy, repeatability, resolution, cosine error, sine errorand Abbé error.
CO02: Students will be to describe the concept of kinematic constraint; analyze and evaluate existing kinematic design approaches to determine degrees of freedom and ability to meet the design intent.
CO03: Students will be able to explain the fundamental concepts in geometric dimensioning and tolerancing.
CO04: Students will be able to select appropriate materials to design a precision component or device considering tradeoffs in performance, cost, machinability, etc.
CO05: Students will be able to apply the concept of error budgeting to the design of an instrument.

Unit I Precision engineering

Introduction - Accuracy & precision – Need – application precision machining –Tool based Micro & Ultra precision Machining grinding – Thermal effects – Materials for tools and machine elements – carbides – ceramic, CBN & diamond.

Unit II Tolerance and fits

Tolerance – Zone – fits – Variation – Hole & shaft system – limits – expected Accuracy of machining processes – Selective assembly – gauges acceptance tests for machine tools.

Unit III Ultra precision machine elements

Introduction – Guide ways – Drive systems – Spindle drive – preferred numbers - Rolling elements – hydrodynamic & hydrostatic bearings – pneumatic bearings.

Unit IV

MEMS Introduction – MEMS – principle – Elements – Characteristics – Design – Application: automobile defence, aerospace etc.,

Unit V Error control

Error – Sources – Static stiffness – Variation of the cutting force – total compliance – Different machining methods – Thermal effects – heat source – heat dissipation – Stabilization – decreasing thermal effects – forced vibration on accuracy – clamping & setting errors – Control – errors due to locations – principle of constant location surfaces.

Text Books

1. Nakazawa, H. Principles of Precision Engineering, Oxford University Press, 1994.
2. Precision Engineering – R.L. Murthy

REFERENCE

1. Institute of Physics Publishing, Bristol and Philadelphia, Bristol, BSI 6BE U.K.

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	ME5CC06	Advanced Machining Processes	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		
ME5CC06	**Advanced Machining Process**	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 working principle of different Hybrid and Micro-machining processes.

CLO05: Students must understand the principles of some commonly used additive manufacturing techniques.

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 learn the capabilities of hybrid processes over individual processes, find their applications and concept of micromachining.

CO05: Students will be able to find applications of additive manufacturing and techniques thereof.

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

Hybrid and Micromachining Processes: Introduction to Electrochemical Grinding and Honing, Abrasive Electro-discharge Machining, EDM with Ultrasonic Assistance, Micro-turning, Micro-milling, Micro-drillingand micro EDM

Unit V

Additive Manufacturing Processes: Introduction to additive manufacturing processes; Classification; Stereolithiography, Laminated Object Manufacturing (LOM), Fused Deposit Modelling (FDM), 3-D Printing. Introduction to Rapid Tooling, Process Modelling

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. V. K. Jain, Introduction to micro machining, Narosa publishing house, New Delhi, 1st Edition, 2010
4. A. Ghosh, Rapid Prototyping: A Brief Introduction, Affiliated East West Press, 2006
5. Chua Chee Kai, Leong Kah Fai, Lim Chu -Sing, Rapid Prototyping: Principles and Applications, 2nd edition, World Scientific, 2003, ISBN: 9812381201.

References:

1. V. K. Jain, Advanced Machining processes, Allied publishers, New Delhi, 2008.
2. G. Benedict, Nontraditional manufacturing processes, Marcel Dekker, New York, 1st Edition, 1987.
3. J. A. McGeough, Advanced methods of machining, Chapman & Hall, London, 1st Edition, 1988
4. A. Ghosh and A. K. Mallik, Manufacturing Science, East-West Press, New Delhi, 2006.

5. D. T. Pham and S. S. Dimov,Rapid manufacturing, Springer-Verlag, 1st Edition, 2001.
6. Peter Hilton, Paul Jacobs, Rapid Tooling- Technologies and Industrial Applications, Marcel Dekker Inc.

List of Experiments

1 Patterndesignandmaking –for onecastingdrawing.
2 Sandpropertiestesting exerciseforstrengthsandpermeability
3 Mouldingmeltingand casting.
4 Arc weldinglap&butt joint
5 Spotwelding
7 Plasma weldingand Brazing (Water plasmadevice).
8 Blankingandpiercingoperationandstudyofsimple, compound andprogressivepress tool.
9 Hydraulicpress: deep drawingandextrusionoperation
11 Injectionmoulding
12 Blowmoulding

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.