Department of Mechanical Engineering

CURRICULUM AND SYLLABUS

(2023-2027)

M. Tech. (Executive) Thermal Engineering

Medi-Caps University
Faculty of Engineering
Syllabus for Master of Technology (Executive) in Thermal Engineering

Mechanical Engineering

M. Tech. (Executive) Thermal 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 practical proble
PEO-2	To develop research acumen for designing a system with better efficiency and per
PEO-3	To prepare students as experts with better communication skills, professional team spirit for working in multidisciplinary teams.

Medi-Caps University
Faculty of Engineering
Syllabus for Master of Technology (Executive) in Thermal Engineering

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, scienc engineering fundamentals, and an engineering specialization to the solution complex engineeringproblems.

PO02 **Problem analysis**: Identify, formulate, research literature, and analyse comple engineering problems reaching substantiated conclusions using first principles 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 environmenta considerations.

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

PO05 **Modern tool usage**: Create, select, and apply appropriate techniques, resource and modern engineering and IT tools including prediction and modeling to comple 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 consequen 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 responsibiliti and norms of engineering practice.

PO09 **Individual and team work**: Function effectively as an individual, and as a memb 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 the engineering and management principlesand apply these to one's own work, as 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 engage in independent and life-long learning in the broadest context of technologic 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	ME5CT02	Advanced Thermodynamics	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	ME5EL21	Elective –I: Advanced Heat Transfer	4	0	0	4
2	ME5CA01	Finite Element Method	4	0	4	6
3	ME5EL22	Elective –II: Advanced Turbo Machines and Power Plants	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	ME5CT05	Computational Fluid Dynamics	4	0	4	6
2	ME5EL23	Elective -III: Advanced Refrigeration and Air-conditioning systems	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	ME5CT06	Design of heat exchangers	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 Thermal Engineering

SEMESTER – I

Sr. No.	Course Code	Course Name	L	T	P	Hours	Credits
1	ME5BS01	Mathematics	4	0	0	4	4
2	ME5CT02	Advanced Thermodynamics	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**		
ME5CT02	**Advanced Thermodynamics** (Common to Automobile Engg./ Thermal Engg.)	4	0	4	8	6

Course Learning Objectives (CLOs)

CLO01: Develop a deep understanding of exergy and its significance in thermodynamics, including the concept of work potential, irreversibility, and second law efficiency.
CLO02: Gain proficiency in thermodynamic property relations, partial derivatives, Maxwell relations, and Clapeyron equation, enabling the analysis of various thermodynamic processes.
CLO03: Acquire knowledge of chemical reactions, combustion processes, and the application of the first and second law of thermodynamics to analyze reacting systems.
CLO04: Understand the properties of gas mixtures, including Avogadro's Law, equation of state, and the behaviour of mixtures under different conditions.
CLO05: Analyze and evaluate vapour and combined power cycles, including their second law analysis and the consideration of cogeneration in combined gas-vapour power cycles.

Course Outcomes (COs)

CO01: Students will be able to apply the concept of exergy and perform exergy analyses for different systems, helping them identify areas for improving energy efficiency and reducing irreversibility.
CO02: Graduates will demonstrate proficiency in using property relations and equations to analyze and solve complex thermodynamic problems, such as determining thermodynamic properties and behaviour of substances under various conditions.
CO03: Students will understand the principles of chemical reactions and combustion processes, allowing them to perform thermodynamic analysis and predict the performance of reacting systems.
CO04: Upon completion, students will be able to apply thermodynamic concepts to gas mixtures, enabling them to analyze the behaviour of mixtures and understand the interactions between individual gases.
CO05; Students will be capable of performing second law analyses of vapour and combined power cycles, and they will have the skills to assess the performance and efficiency of these cycles, including cogeneration applications.

Unit-I

Exergy: Work potential of energy, Reversible work and irreversibility, second law efficiency, exergy change of system, exergy transferred by Heat, Work & Mass, Exergy balance in open and close system.

Unit-II

Thermodynamics Property Relations: partial derivatives, Maxwell relations, Clapeyron Equation, General relations for du, dh, ds, Cv&Cp, Joule Thomson coefficient, Δh, , Δu, Δs for real gases.

Unit-III

Chemical Reactions: Fuels and combustion, Theoretical & actual combustion processes, enthalpy of formation & enthalpy of combustion, First & Second law analysis of reacting system, Adiabatic flame temperature.

Unit-IV

Properties of Gas Mixtures: Avogadro's Law, equation of state, Virial expansions, Law of corresponding states, Dalton's law of partial pressure, internal energy, enthalpy & specific heats of gases forming mixture, entropy of mixture of gases, Gibbs Function.

Unit-V

Vapour & combined Power cycle: Second law analysis of vapour power cycles, Cogeneration combined Gas Vapour Power cycles, Second law analysis of Gas power cycles.

Text Books

1. Thermodynamics:- An Engineering approach "Yunus A. Cengel& Michael A. Boles", McGraw Hill Educations.
2. Thermal Science "Merle C. Potter & Elaine P. Scolt", Cengatge Learning 3. Engineering Thermodynamics "P K Nag", McGraw Hill Educations

List of Experiments:

1. MATLAB programming for problem solving of Fluid Mechanics, Thermal Engineering and Heat Transfer Problems
2. C programming for problem solving of Fluid Mechanics, Thermal Engineering and Heat Transfer Problems
3. Solving Thermal Engineering problems using available packages such as T K Solver: ANSYS, CFX, STARCD, MATLAB, FLUENT etc.

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	ME5EL21	Elective –I: Advanced Heat Transfer	4	0	0	4	4
2	ME5CA01	Finite Element Method	4	0	4	8	6
3	ME5EL22	Elective –II: Advanced Turbo Machines and Power Plants	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		
ME5EL21	**Advanced Heat Transfer** (Elective-I)	4	0	0	4	4

Course Learning Objectives (CLOs)

CLO01: Understanding of heat transfer processes and their relevance to industrial problems.
CLO02: To understand the derivation and physical meaning of energy transport equations.
CLO03: To strengthen analytical, numerical and computational skills to solve complex heat transfer problems.
CLO04: To provide experience in treating multimode heat transfer effects and in solving realistic engineering problems.
CLO05: To understand the heat transfer concepts apply to other domain of thermal engineering in general.

Course Outcomes (COs)
At the end of the course, student will be able to:

CO01: Analyze steady state and transient heat conduction problems of real life Thermal systems.
CO02: Analyze extended surface heat transfer problems and problems of phase change heattransfer like boiling and condensation.
CO03: Apply the basic principles of classical heat transfer in real engineering application.
CO04: Analyze the analytical and numerical solutions for heat transfer problem.
CO05: Analyze radiation heat transfer problems of various thermal systems.

Unit-I
Radiation Heat Transfer: The view factor, View factor relations, Black Surface, diffuse, grey surface radiation shields, Gas radiation, Radiation effects, Formation of numerical solution, Solar radiation.

Unit-II
Numerical Methods in Heat Conduction: Why Numerical Methods, Finite difference formulation of differential equation, One dimensional steady state conduction, Two dimensional Steady state conduction:- (Finite Element Method) Finite difference formulation, Boundary Nodes, Irregular Boundaries, Transient heat conduction.

Unit-III
Boiling and Condensation: Boiling heat transfer, pool boiling, flow boiling, film condensation regimes, effect of vapour velocity, dropwise condensation, condensation number.

Unit-IV

Lamirar Boundary layer: on a flat plate, energy equation of boundary layer, Thermal boundary layer, Turbulent Heat transfer, turbulent Prandtl number, Free convection Heat transfer on vertical plate, cylinders, inclined surfaces.

Unit-V

Cooling of electronic equipment, Heating & cooling of buildings, Refrigeration of foods, Freezing of foods like fruits, vegetables, poultry & fish etc.

Text Books

1. Heat & Mass Transfer: Yunus A. Cengel& A fshin J. Ghajar, Mc Graw Hill
2. Heat Transfer; J P Holman & Sovik Bhattacharya, Mc Graw Hill
3. Engineering Heat & Man Transfer;Mahesh M. Rathore University Press

.

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		
ME5EL22	**Advanced Turbo Machines and Power Plants** (Elective-II)	4	0	0	4	4

Course Learning Objectives (CLOs)

CLO01: Students should understand the knowledge of basic principles, governing equations and applications of turbo machine.
CLO02: Students must understand the opportunities to apply basic thermo-fluid dynamics flow equations to Turbo machines.
CLO03: Students must be able toexplain construction and working principle and evaluate the performance characteristics of Turbo Machines.
CLO04: Students must understand thebasic knowledge of different types of Power Plants, site selection criteria of each one of them.
CLO05: Students must be able to discuss environmental and safety aspects of power plant operation.

Course Outcomes (COs)

After the successful completion of the course, students will be able to:
CO01: Apply thermodynamics and kinematics principles to turbo machines.
CO02: Analyze the performance of turbo machines.
CO03: Ability to select turbo machine for given application.
CO04: Explain the economics involved in Power Plant and identify the factors related to selection of plant.
CO05: Explain the components, principles and working of nuclear & non-conventional power plant.

UNIT-I

Introduction to Turbomachines. Classification of Turbomachines. Second Law of Thermo dynamics - turbine/compressor work, Nozzle/diffuser work. Fluid equations - continuity, Euler's, Bernoulli's equation and its applications. Expansion and compression processes, Reheat Factor, Preheat Factor.

UNIT-II

Euler's Equation of Energy Transfer, vane congruent flow, influence of relative circulation, thickness of vanes, number of vanes on velocity triangles, slip factor, Stodola, Stanitz and Balje's slip factor. Suction pressure and net positive suction head. Phenomena of cavitation in pumps. Concept of specific speed, Shape number. Axial, Radial and Mixed Flow Machines. Similarity laws.

UNIT–III

Flow through Axial flow fans. Principles of Axial fan and propeller. Application of fans for air circulation and ventilation. Stage pressure rise and work done. Slip stream and Blade Element theory for propellers. Performance and characteristics of axial fans.

Unit – IV

Thermal Power Generation: Operating Principle, Site selection, Coal to Electricity, General Layout of Thermal Power Plant, Brief description of different parts/systems and their functions, Advantages and Limitations.

Unit–V Gas Power Generation : Operating Principle; Classification – Open Cycle, Closed Cycle, Combined Cycle; Fuels for Gas Turbine Power Plants; Different Components and their functions; Gas Turbine Characteristics, Cycle Efficiency, Operational Aspects, Advantages and Limitations.

Text Book/ References:

1. S.M. Yahya, Turbines, Compressors and Fans, Tata McGraw Hill.
2. Gopalakrishnan G, Prithvi Raj D, "A treatise on Turbomachines", Scitec Publications, Chennai, 2002.
3. Sheppard, Principles of Turbomachinery.
4. R.K.Turton, Principles of Turbomachinery, E & F N Spon Publishers, London & New York.
5. Power Plant Engineering – P.C.Sharma / S.K.Kataria Pub.
6. A Course in Power Plant Engineering: / Arora and S. Domkundwar.
7. A Text Book of Power Plant Engineering / Rajput / Laxmi Publications

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	ME5CT05	Computational Fluid Dynamics	4	0	4	8	4
2	ME5EL23	Elective -III: Advanced Refrigeration and Air-conditioning systems	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**		
ME5CT05	**Computational Fluid Dynamics**	4	0	4	8	4

Course Learning Objectives (CLOs)

CLO01: Students should understand the governing equation based on basic principles of fluid flow.
CLO02: Students must understand the finite difference method to model the fluid flow.
CLO03: Students must understand the grid generation techniques to model fluid flow.
CLO04: Students must understand the different CFD techniques to analyze the fluid flow.
CLO05: Students must understand how to model turbulent flow.

Course Outcomes (COs)

CO01: Students will be able to develop governing equations for a given fluid flow problem.
CO02: Students will use Finite Difference Method to find solution for a given fluid flow condition.
CO03: Students will be able to use different grid generation techniques for the given problem.
CO04: Students will be able to apply a particular CFD Technique for a given problem.
CO05: Students will be able to apply CFD techniques to analyze turbulent flow.

UNIT I

Introduction to Computational Fluid Dynamics and Principles of Conservation: Continuity Equation, Navier Stokes Equation, Energy Equation and General Structure of Conservation Equations, Classification of Partial Differential Equations and Physical Behaviour, Approximate Solutions of Differential Equations: Error Minimization Principles.

UNIT II

Fundamentals of Discretization: Finite Element Method, Finite Difference and Finite Volume Method, Consistency, Stability and Convergence. 1-D Steady State Diffusion Problems- Source term linearization, Implementation of boundary conditions.

UNIT III

Finite Volume Discretization of 2-D unsteady State Diffusion type Problems, Solution of Systems of Linear Algebraic Equations: Elimination Methods, Iterative Methods

UNIT IV

Discretization of Navier Stokes Equations, primitive variable approach, SIMPLE Algorithm, SIMPLER Algorithm, Unstructured Grid Formulation.

UNIT V

Introduction to Turbulence Modelling, Important features of turbulent flow, General Properties of turbulent quantities, Reynolds average Navier stokes (RANS) equation, Closure problem in turbulence: Necessity of turbulence modelling and applications.

TEXT BOOKS/REFERENCES:

1. Versteeg, H.K., and Malalasekara, W, "An Introduction to Computational Fluid Dynamics", The Finite Volume Method, 2007.
2. Moukalled, F., Mangani, L., & Darwish, M. "The finite volume method in computational fluid dynamics. An Advanced Introduction with Open FOAM and Matlab", 2016.
3. Patankar, S.V., "Numerical Heat Transfer and Fluid Flow", Hemisphere Publishing Corporation, 1980.
4. Anderson, J. D., & Wendt, J., "Computational fluid dynamics" (Vol. 206). New York: McGraw-Hill, 1995.

List of Experiments:-

1. 3D geometry creation using ICEM CFD
2. Computational analysis of Jet surface interaction
3. Simulation of shell and tube heat exchanger
4. Computational investigation of a hydraulic jump
5. Analysis of a moving strip in an air stream
6. Simulation of a blower using multiple reference frames model
7. Simulation of Species transport and gaseous combustion
8. Simulation of a porous media

Subject Code	Subject Name	Hours per Week			Hours	Credits
		L	**T**	**P**		
ME5EL23	**Advanced Refrigeration and Air-conditioning systems** (Elective-III)	4	0	0	4	4

Course Learning Objectives (CLOs)

CLO01: Understand the principles and working of various refrigeration cycles and systems, including vapour compression, multi-pressure, air refrigeration, steam jet, and thermo-electric refrigeration.
CLO02: Familiarize with the history, nomenclature, classification, and characteristics of refrigerants, with a special focus on eco-friendly alternatives.
CLO03: Analyze and design simple and industrial vapour absorption systems using differentworking fluids and absorbent combinations.
CLO04: Acquire knowledge of psychrometry, psychometric charts, and HVAC systems, including cooling load estimation, temperature and humidity controls, and various air conditioning systems like Window AC, Split AC, and central air conditioning.
CLO05: Gain expertise in the design and selection of evaporators, cooling towers, air washers, pumps, fans, and duct systems for efficient heat transfer and energy conservation.

Course Outcomes (COs)

CO01: Students will be able to analyze and evaluate different refrigeration cycles and systems, enabling them to make informed decisions in selecting the appropriate system for specific applications.
CO02: Students will demonstrate an understanding of the characteristics of refrigerants, their environmental impact, and the ability to recommend eco-friendly refrigerants for sustainable cooling solutions.
CO03: Upon completion, students will be capable of designing and evaluating vapour absorption systems, considering various working fluids and absorbent combinations for efficient and effective refrigeration.
CO04: Students will be proficient in estimating cooling loads, controlling temperature and humidity, and designing HVAC systems, including various types of air conditioning systems for automotive applications.
CO05: Students will possess the skills to design and optimize components such as evaporators, cooling towers, pumps, fans, and ducts, focusing on energy conservation and improving overall system performance in automotive air conditioning applications.

Unit I Components of Vapour Compression System

The condensing unit – Evaporators – Expansion valve – Refrigerants – Properties – ODP & GWP - Load balancing of vapour compression Unit.
Compound Compression: Flash inter-cooling – flash chamber – Multi-evaporator & Multistage systems.

Unit II Production of low temperature

Liquefaction system; Cascade System – Applications. – Dry ice system.
Vapour absorption system – Simple and modified aqua – ammonia system – Representation on Enthalpy –Concentration diagram. Lithium – Bromide system Three fluid system – HCOP.

Unit III Air Refrigeration
Applications – Air Craft Refrigeration -Simple, Bootstrap, Regenerative and Reduced ambient systems – Problems based on different systems.
Steam Jet refrigeration system: Representation on T-s and h-s diagrams – limitations and applications.
Unconventional Refrigeration system – Thermo-electric – Vortex tube & Pulse tube – working principles

Unit IV Air –Conditioning
Psychometric properties and processes – Construction of Psychometric chart. Requirements of Comfort Air –conditioning – Thermodynamics of human body – Effective temperature and Comfort chart – Parameters influencing the Effective 8 Temperature. Summer , Winter and year round air – conditioning systems. Cooling load Estimation: Occupants, equipments, infiltration, duet heat gain fan load, Fresh air load.

Unit VAir –Conditioningsystem
All Fresh air , Re-circulated air with and without bypass, with reheat systems – Calculation ofBypassFactor, ADP,RSHF, ESHF and GSHF for different systems. Components: Humidification and dehumidification equipment – Systems of Air cleaning – Grills and diffusers – Fans and blowers – Measurement and control of Temperature and Humidity.

Text and Reference Books:

1. Refrigeration & Air Conditioning /C.P. Arora/TMH
2. Refrigeration & Air Conditioning /Arora&Domkundwar/ DhanpatRai
3.Refrigeration and Air Conditioning /Manohar Prasad/
4.Refrigeration and Air Conditioning /Stoecker /Mc Graw Hill
5.Principles of Refrigeration/Dossat /Pearson
6.Refrigeration and Air Conditioning /Ananthanarayana /TMH
7. Refrigeration and Air Conditioning /Jordan& Preister /Prentice Hall
8. Refrigeration and Air Conditioning/Dossat /Mc Graw Hill

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

Medi-Caps University
Faculty of Engineering
Syllabus for Master of Technology (Executive) in Thermal Engineering

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	ME5CT06	Design of heat exchangers	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**		
ME5CT06	**Design of Heat Exchangers**	4	0	4	8	6

Course Learning Objectives (CLOs)
CLO01: Students should be able to select the appropriate heat exchanger
CLO02: Students must beable to estimate fouling rates according to design conditions CLO03: Students must be ableto perform sizing and rating of heat exchangers for complicated designs.
CLO04: Students mustbe able to design, analyze and evaluate heat exchangers.
CLO05: Students must be able to perform optimum design of heat exchangers.

Course Outcomes (COs)
After the successful completion of the course, students will be able to:
CO01:Outline common types of heat exchangers.
CO02: Analyze the performance of heat exchangers.
CO03: Design the double pipe heat exchangers.
CO04: Design Shell & tube heat exchangers.
CO05: Evaluate the performance of heat exchangers.

Unit-I
Classification of heat exchangers, basic design methods for heat exchangers

Unit-II
Design of tube in tube and shell and tube heat exchangers, TEMA code

Unit-III
Power plant heat exchangers, heat exchangers for heat recovery at low, medium and high temperatures, computerized methods for design and analysis of heat exchangers, compact heat exchangers.

Unit-IV
Principles of boiler design, codes for mechanical design of heat exchangers

Unit-V
Performance enhancement of heat exchangers, fouling of heat exchangers, testing, evaluation and maintenance of heat exchangers.

Text Books:

1. Saunders, E.A.D., “Heat Exchangers – Selection Design and Construction”, Longmann Scientific and Technical, N.Y., 2001.
2. Kays, V.A. and London, A.L., “Compact Heat Exchangers” , McGraw Hill, 2002.
3. Holger Martin, “Heat Exchangers” Hemisphere Publ. Corp. , Washington, 2001.
4. Kuppan, T., “Heat Exchanger Design Handbook”, Marcel Dekker, Inc., N.Y. , 2000
5. Seikan Ishigai, “Steam Power Engineering, Thermal and Hydraulic Design Principles”, Cambridge Univ. Press, 2001.

List of Experiments:

1. Study of fundamentals of Fluid Flow and Heat Transfer associated with heat exchangers. 2. Design of heat exchange equipment by using method of LMTD.
3. Design of heat exchange equipment by using method €– NTU.
4. Design and analysis of Parallel flow and Counter flow heat exchanger.
5. Design and analysis of Shell and tube type heat exchanger.
6. Design and analysis of Plate type heat exchanger.
7. Design of evaporator and condenser for refrigeration system.
8. Design of cooling and air conditioning circuit.

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.