

M.TECH - THERMAL POWER ENGINEERING (22 SCHEME)	
Course Code	22MTP11- Applied Mathematics
CO1	Acquire the idea of significant figures, types of errors during numerical computation
CO2	Develop the mathematical models of thermal system using ODE's and PDE's.
CO3	Learn the deterministic approach for statistical problems by using probability distributions
CO4	Classify and analyze mathematical tools applied to thermal engineering study cases.
Course Code	22MTP12- Theory and Design of Modern IC Engine
CO1	To explore the knowledge of performance parameters and its characteristics, variables effect the performance of engine and methods of improving engine performance of internal combustion engine.
CO2	Analyze combustion and apply remedial measures to avoid abnormal combustion in SI and CI Engine
CO3	Analyze different electronic fuel injection system, supercharging and its effect on performance of SI and CI engine.
CO4	Apply various emission control system and modification to take corrective actions to reduce pollution
Course Code	22MTP13- Advanced Fluid Mechanics
CO1	Illustrate the basic concepts fluid flow and their governing equations
CO2	Analyse the laminar and turbulent flow problems.
CO3	Demonstrate the concept of boundary layer equations and drag and lift force
CO4	Distinguish normal and oblique shocks and their governing Equations.
CO5	Explain the Propagation of sound waves and Comparison of isentropic and adiabatic processes in fluid mechanics.
Course Code	22MTP14- Advanced Thermodynamics and Combustion
CO1	Illustrate the basic concepts on First & Second Law Analysis, entropy, and exergy analysis in thermodynamic systems.

CO2	Analyse the Thermodynamic property relations and its application to gas mixtures, phase change processes.
CO3	Demonstrate the Combustion fundamentals involving premixed and nonpremixed flames for laminar and turbulent combustion.
CO4	Explain the fundamental of properties of gas mixtures, chemical reactions, and chemistry of combustion.
CO5	Applications of Combustion phenomena in practical occurring applications such IC and GT engines.
Course Code	22MTP15- Finite Element Method in Heat Transfer
CO1	Recall Governing Equations for Heat Conduction for solving 1-D thermal problems using Approximate methods, Rayleigh – Ritz Methods and Galerkin’s methods.
CO2	Formulate the element characteristic for linear and Quadratic matrices and vectors for 1-D and 2-D problems.
CO3	Explain the Formulation of Heat Conduction Equations for 1D, 3-D, Fin, and Nonlinear Heat conduction for developing mathematical models
CO4	Demonstrate the Application of numerical methods on heat transfer problems, Convective Heat Transfer and Fluid Mechanics Problems.
Course Code	22RMI16- Research Methodology and IPR
CO1	Discuss research methodology and the technique of defining a research problem
CO2	Explain the functions of the literature review in research, carrying out a literature search, developing theoretical and conceptual frameworks and writing a review.
CO3	Explain various research designs, sampling designs, measurement and scaling techniques and different methods of data collections.
CO4	Explain several parametric tests of hypotheses, Chi-square test, art of interpretation and writing research reports
CO5	Discuss various forms of the intellectual property, its relevance and business impact in the changing global business environment and leading International Instruments concerning IPR
Course Code	22MTPL17 - FEM & Simulation Lab
CO1	Develop skills in making geometry and meshing for various configurations using ANSYS Workbench.
CO2	Develop knowledge in CFD simulation of Convective heat transfer and phase change problems using ANSYS Workbench.

CO3	Develop knowledge in simulation of lamina and turbulent flow using ANSYS Workbench.
CO4	Develop MATLAB programme for simulation of IC engine performances.
Course Code	22MTP21- Advanced Power Plant Cycles
CO1	Describe the power generation scenario, the layout components of thermal power plant and analyze the improved Rankin cycle, Cogeneration cycle.
CO2	Analyze the steam condensers, recognize the environmental impacts of thermal power plant and method to control the same.
CO3	Recognize the layout, component details of hydroelectric power plant and nuclear power plant
CO4	Describe the different power plant electrical instruments and basic principles of economics of power generation
Course Code	22MTP22- Advanced Heat Transfer
CO1	Ability to understand modes of heat transfer with energy equation and develop models for physical problems and analyze steady state, fins, and transient heat conduction problems of real-life thermal systems
CO2	Identify and explain the concepts of Boundary layers using Laminar and turbulent conditions.
CO3	Understand and recognize the free and forced convection problems in real time applications.
CO4	Apply different methods for solution of radiative heat transfer problems in nonparticipating and participating medium and applications of boiling and condensation in industry
CO5	Demonstrate the importance of heat exchanger and its applications in industry.
Course Code	22MTP231- Steam and Gas Turbines
CO1	Describe the working principles of Gas and steam turbine nozzles and diffusers
CO2	Designate the working principles of impulse and reaction turbines using velocity triangles
CO3	Use the concepts of State Point Locus Reheat Factor and Identify the various losses associated with the turbines.
CO4	Illustrate the concepts of axial flow and centrifugal compressors and its application in gas turbine.
CO5	Explain the concepts of open and closed cycle gas turbine and its application in jet propulsion.

Course Code	22MTP232- Renewable Energy Technology
CO1	Describe measurement of direct, diffuse, and global solar radiations falling on horizontal and inclined surfaces, Basic earth sun angles, Beam and diffuse radiations, Radiation on titled surfaces.
CO2	Analyze the performance by conducting research on flat plate collector, air heater and concentrating type collector. Understand test procedures and apply these while testing different types of collectors.
CO3	Demonstrate and Design various types of thermal energy storage systems. Analyze payback period and annual solar savings due to replacement of conventional systems
CO4	Demonstrate the importance of solar energy effectively to increase awareness of it in society.
CO5	Describe measurement of direct, diffuse, and global solar radiations falling on horizontal and inclined surfaces, Basic earth sun angles, Beam and diffuse radiations, Radiation on titled surfaces.
Course Code	22MTP233- Design and Optimization of Thermal Energy Systems
CO1	Formulation of design problems related to thermal Systems.
CO2	Apply methods of optimization to solve a linear, non-linear programming problem by various methods.
CO3	Optimize engineering problem of nonlinear programming with/without constraints, by using this technique
CO4	Use of dynamic programming problem in controlling in industrial managements.
CO5	Simulate Thermal engineering system problem. Understand integer programming and stochastic programming to evaluate advanced optimization techniques.
Course Code	22MTP234- Cryogenics
CO1	Understand the working principles and applications of different types of gas liquefaction and refrigeration systems.
CO2	Understanding the governing laws and principles of gas separation
CO3	Illustrate Ideal separation, properties of mixtures, Rectifiers column, separation of air, purification.
CO4	Understanding the importance of cryogenics insulations and Safety in Cryogenics.
CO5	Study and describe Insulation and storage systems in cryogenic engineering
Course Code	22MTP235- Nuclear Engineering in Power Generation

CO1	Understand the basic physics of nuclear reactions
CO2	Basic concepts of nuclear fuel manufacturing and spent fuel handling
CO3	Classification of nuclear reactors
CO4	Understand working principle of thermal reactor
CO5	Analyse the thermal hydraulics of nuclear reactors
Course Code	22MTP241 - Refrigeration and Air Conditioning
CO1	Understand concepts of refrigeration and air-conditioning process and systems.
CO2	Employ the theoretical principles to simple, complex vapour compression and vapour absorption refrigeration systems.
CO3	Understand conventional and alternate refrigerants and their impact on environment.
CO4	Apply the heat load calculation to design the air-conditioning systems.
CO5	Describe the concepts to design air distribution systems.
Course Code	22MTP242 - Hydrogen and Fuel Cell Technologies
CO1	Apply know-how of thermodynamics, electrochemistry, heat transfer, and fluid mechanics principles to design and analysis of this emerging technology.
CO2	Have thorough understanding of performance behaviour, operational issues and challenges for all major types of fuel cells.
CO3	Identify, formulate, and solve problems related to fuel cell technology keeping in mind economic viability.
CO4	Use the techniques, skills, and modern engineering tools necessary for design and analysis of innovative fuel cell systems.
CO5	Understand the impact of this technology in a global and societal context. Develop enough skills to design systems or components of fuel cells.
Course Code	22MTP243 - Jet and Rocket Propulsion systems
CO1	Understand the aero thermo chemistry of the combustion products

CO2	Apply knowledge of features and capabilities of chemical and non-chemical rocket propulsion systems.
CO3	Apply the concepts to ramjet and jet propulsion system.
CO4	Calculate the specific impulse and mass flow for a rocket engine with the fluid considered as an ideal gas with constant specific heats.
CO5	Estimate the specific impulse and mass flow for a rocket engine accounting for chemical reaction and non-constant specific heats.
Course Code	22MTP244 - Computational Methods in Heat Transfer and Fluid Flow
CO1	To derive the stepwise procedure to completely solve a fluid dynamics problem using computational methods.
CO2	To explain the governing equations and understand the behaviour of the equations.
CO3	To determine the consistency, stability, and convergence of various discretization schemes for parabolic, elliptic and hyperbolic partial differential equations.
CO4	To verify variations of SIMPLE schemes for incompressible flows and Variations of Flux Splitting algorithms for compressible flows.
CO5	To identify various methods of grid generation techniques and application of finite difference and finite volume methods to various thermal problems.
Course Code	22MTP245 - Energy Conservation and Management
CO1	Understand the various energy conservation and improvement techniques
CO2	Illustrate the Energy scenario.
CO3	Employ the principles of thermal engineering and energy management to improve the Performance of thermal systems.
CO4	Assess energy projects based on economic and financial criteria.
CO5	Describe methods of energy production for improved utilization.
Course Code	22MTP225 - MINI PROJECT WITH SEMINAR
CO1	Present the mini-project and be able to defend it
CO2	Make links across different areas of knowledge and to generate, develop and evaluate ideas and information to

	apply these skills to the project task.
CO3	Habituated to critical thinking and use problem solving skills
CO4	Communicate effectively and to present ideas clearly and coherently in both the written and oral forms
CO5	Work in a team to achieve common goal.
CO6	Learn on their own, reflect on their learning and take appropriate actions to improve it.
Course Code	22MTPL26 - CFD and Numerical Lab
CO1	Develop knowledge in coding to simulate the flow in a Lid driven cavity
CO2	Develop skills in coding for natural convection heat transfer in enclosures.
CO3	Develop skills in making geometry and meshing for various configurations using ANSYS Workbench.
CO4	Develop knowledge in CFD simulation of Convective heat transfer and phase change problems using ANSYS Workbench.
CO5	Develop knowledge in simulation of turbulent flow using ANSYS Workbench.
Course Code	22MTP31 - Design of Heat Transfer Equipment's
CO1	Understand the physics and the mathematical treatment of typical heat exchangers and employ LMTD and Effectiveness methods in the design of heat exchangers
CO2	Design, analyze and examine the performance of double-pipe counter flow (hair-pin) and shell and tube heat exchanger
CO3	Understand the fundamental, physical and mathematical aspects of and condensation.
CO4	Demonstrate the importance of Vaporizers, Evaporators and Reboilers as heat exchangers
CO5	Classify cooling towers and explain their technical features.
Course Code	22MTP32 - Alternative Fuels for IC Engines
CO1	Explain about the availability and usage of conventional fuels for IC engines
CO2	Identify possible alternative fuels for IC engines.

CO3	Demonstrate the use of alternative fuels for different types of engines
CO4	Assess the environmental impact standards and procedures of using alternate fuels.
CO5	Describe and analyze Need for alternative fuels such as Ethanol, Methanol, LPG, CNG, Hydrogen and their manufacturing procedure.
Course Code	22MTP322 - Thermal Power Station
CO1	Describe the working principle, operation, and maintenance of a various steam generators.
CO2	Identify the arrangements of different flow systems their operation and maintenance.
CO3	Illustrate the impact of thermal power plant exhaust on environment
CO4	Estimate the working expenses, current scenario and trends in power generation.
CO5	Asses the performance and suitability of thermal power plant.
Course Code	22MTP323 - Convective Heat and Mass Transfer
CO1	Understand the fundamental and advanced principles of forced and natural convection heat transfer processes.
CO2	Formulate and solve convective heat transfer problems
CO3	Relate the principles of convective heat transfer to estimate the heat dissipation from devices.
CO4	Estimate the energy requirements for operating a flow system with heat transfer.
CO5	Relate to the current challenges in the field of convective heat transfer.
Course Code	22MTP324 - Gas Dynamics
CO1	Apply continuity, momentum, and energy equations to compressible flows.
CO2	Analyze isentropic and non-isentropic flows across normal shock waves.
CO3	Solve compressible flow problems involving heat transfer and friction.
CO4	Apply conservation laws to fluid flow problems and gain knowledge about main properties which are used for analyzing or modelling of compressible flow

CO5	Solve flow problems with heat addition and with friction and Simulation of One-dimensional flow in Shock tube.
Course Code	22MTP325 - Measurement Systems in Thermal Engineering
CO1	Understand the concepts of errors in measurements, statistical analysis of data, regression analysis, correlation, and estimation of uncertainty.
CO2	Describe the working principles in the measurement of field and derived quantities.
CO3	Examine sensing requirements for measurement of thermo-physical properties, radiation properties of surfaces, and vibration
CO4	Understand conceptual development of zero, first and second order systems
CO5	Interpret International Standards of measurements (ITS-90) and identify internationally accepted measuring standards for measurands.
Course Code	22MTP331 - Theory of IC Engines
CO1	Understand the concepts of errors in measurements, statistical analysis of data, regression analysis, correlation, and estimation of uncertainty.
CO2	Describe the working principles in the measurement of field and derived quantities.
CO3	Examine sensing requirements for measurement of thermo-physical properties, radiation properties of surfaces, and vibration.
CO4	Understand conceptual development of zero, first and second order systems
CO5	Interpret International Standards of measurements (ITS-90) and identify internationally accepted measuring standards for measurands.
Course Code	22MTP332 - Environmental Engineering and Pollution Control
CO1	Grasp the fundamentals of air pollution and its associated environmental impacts.
CO2	Earn to describe the key concepts of air quality management.
CO3	Do sampling and characterization of solid waste and analysis of hazardous waste constituents including QA/QC issues
CO4	Apply steps in solid waste management-waste reduction at source, collection techniques, materials and resource recovery/recycling, transport, optimization of solid waste transport, treatment and disposal techniques.

CO5	Schemes, incentives, policies on industrial waste management and Overview of product design for waste minimization.
Course Code	22MTP333 - Safety in Engineering Industry
CO1	Describe the theories of accident causation and preventive measures of industrial accidents.
CO2	Explain about personal protective equipment, its selection, safety performance & indicators and importance of housekeeping.
CO3	Explain different issues in construction industries.
CO4	Describe various hazards associated with different machines and mechanical material handling.
CO5	Utilise different hazard identification tools in different industries with the knowledge of different types of chemical hazards.
Course Code	22MTP334 - Biomass Energy Conversion Techniques
CO1	Develop knowledge in properties of biomass and energy conversion process
CO2	Compare the characteristics of products obtained from biomass pyrolysis.
CO3	Understand the basics of biomass gasification and gasifier design.
CO4	Assess the potential of electrical power production from biomass.
Course Code	22MTP335 - Non-Conventional Energy Sources
CO1	Demonstrate the generation of electricity from various Non-Conventional sources of energy, have a working knowledge on types of fuel cells.
CO2	Estimate the solar energy, Utilization of it, Principles involved in solar energy collection and conversion of it to electricity generation.
CO3	Explore the concepts involved in wind energy conversion system by studying its components, types and performance.
CO4	Illustrate ocean energy and explain the operational methods of their utilization.
CO5	Acquire the knowledge on Geothermal energy.

Course Code	22MTP34 - PROJECT WORK PHASE – 1
CO1	Demonstrate a sound technical knowledge of their selected project topic.
CO2	Undertake problem identification, formulation, and solution.
CO3	Design engineering solutions to complex problems utilising a systems approach
CO4	Communicate with engineers and the community at large in written and oral forms.
CO5	Demonstrate the knowledge, skills and attitudes of a professional engineer.
Course Code	22MTPI36 - INTERNSHIP
CO1	Gain practical experience within industry in which the internship is done.
CO2	Acquire knowledge of the industry in which the internship is done.
CO3	Apply knowledge and skills learned to classroom work.
CO4	Develop a greater understanding about career options while more clearly defining personal career goals.
CO5	Experience the activities and functions of professionals
CO6	Develop and refine oral and written communication skills
CO7	Identify areas for future knowledge and skill development.
CO8	Expand intellectual capacity, credibility, judgment, intuition.
CO9	Acquire the knowledge of administration, marketing, finance and economics.
Course Code	22MTP41 - PROJECT WORK PHASE -2
CO1	To support independent learning
CO2	To guide to select and utilize adequate information from varied resources maintaining ethics.
CO3	To guide to organize the work in the appropriate manner and present information (acknowledging the sources) clearly
CO4	To develop interactive, communication, organisation, time management, and presentation skills.

CO5	To impart flexibility and adaptability.
CO6	To inspire independent and team working.
CO7	To expand intellectual capacity, credibility, judgement, intuition.
CO8	To adhere to punctuality, setting and meeting deadlines.
CO9	To instill responsibilities to oneself and others.
CO10	To train students to present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchange ideas.