SRI SIDDHARTHA INSTITUTE OF TECHNOLOGY- TUMAKURU

(A constituent College of Siddhartha Academy of Higher Education, Tumakuru)

CHOICE BASED CREDIT SYSTEM (CBCS)

SCHEME OF TEACHING AND EXAMINATION FOR M.Tech. COURSE

(Effective from the academic year 2024-2025)

DEPARTMENT OF MECHANICAL ENGINEERING

M.Tech (THERMAL POWER ENGINEERING)

1st SEMESTER MTech

SI No	Course Code		Course Title	Teaching Dept.	L	T	P	Credits	CIE Marks	SEE Marks	Total Marks	Exam Hrs.
1	PC	24TPE11	Applied Mathematics	MA	4	-	-	4	50	50	100	3
2	PC	24 TPE 12	Advanced Power Plant Cycles	ME	4	-	-	4	50	50	100	3
3	PC	24 TPE 13	Advanced Fluid Mechanics	ME	4	-	-	4	50	50	100	3
4	PC	24 TPE 14	Combustion Engineering Science	ME	3	-	-	3	50	50	100	3
5	PE	24 TPE 15x	Professional Elective-I	ME	3	-	-	3	50	50	100	3
6	PE	24 TPE 16x	Professional Elective-II	ME	3	-	-	3	50	50	100	3
7	PC	24 TPE TS1	Technical Seminar-I	ME	-		3	1.5	50	-	50	-
8	PC	24 TPE LB1	Thermal Engineering Laboratory	ME	-	-	3	1.5	50	-	50	-
L: Lecture, T-Tutorial, P-Practical/Drawing, CIE: Continuous Internal Evaluation, SEE: Semester End Examination				**Total**	**21**	**-**	**6**	**24**	**400**	**300**	**700**	**-**

Professional Elective-I		Professional Elective-II	
24TPE151	Energy Conservation and Management	24TPE161	Theory of IC Engines
24TPE152	Thermal Power Station	24TPE162	Refrigeration and Air Conditioning
24TPE153	Modeling & Simulation of Thermal Systems	24TPE163	Experimental Methods in Thermal Power Engineering

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(Effective from the academic year 2024-2025)

DEPARTMENT OF MECHANICAL ENGINEERING

M.Tech (THERMAL POWER ENGINEERING)

2nd SEMESTER MTech

SI No	Course Code		Course Title	Teaching Dept.	L	T	P	Credits	CIE Marks	SEE Marks	Total Marks	Exam Hrs.
1	PC	24 TPE 21	Heat Transfer	**ME**	4	-	-	**4**	50	50	100	3
2	PC	24 TPE 22	Turbomachines	**ME**	4	-	-	**4**	50	50	100	3
3	PC	24 TPE 23	Finite Element Method	**ME**	4	-	-	4	50	50	100	3
4	PC	24 TPE 24	Advanced Design of Heat Transfer Equipments	**ME**	3	-	-	3	50	50	100	3
5	PE	24 TPE 25x	**Professional Elective-III**	**ME**	3	-	-	**3**	50	50	100	3
6	PE	24 TPE 26x	**Professional Elective-IV**	**ME**	3	-	-	**3**	50	50	100	3
7	PC	24 TPE TS2	**Technical Seminar-II**	**ME**	-	-	3	**1.5**	50	-	50	-
8	PC	24 TPE LB2	CAE Laboratory	**ME**	-	-	3	**1.5**	50	-	50	-
L: Lecture, T-Tutorial, P-Practical/Drawing, CIE: Continuous Internal Evaluation, SEE: Semester End Examination				**Total**	21	**-**	6	24	**400**	**300**	700	**-**

Professional Elective-III		**Professional Elective-IV**	
24TPE251	Alternate Fuels for IC Engine	24TPE261	Solar Thermal Technologies and applications
24TPE252	Computational and Fluid Dynamics	24TPE262	Design and Analysis of Thermal Systems
24TPE253	Convective heat transfer	24 TPE263	Engine Flow and Combustion

SRI SIDDHARTHA INSTITUTE OF TECHNOLOGY- TUMAKURU

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SCHEME OF TEACHING AND EXAMINATION FOR M.Tech. COURSE

(Effective from the academic year 2024-2025)

DEPARTMENT OF MECHANICAL ENGINEERING

M.Tech (THERMAL POWER ENGINEERING)

3rd SEMESTER MTech

SI No	Course Code		Course Title	Teaching Dept.	L	T	P	Credits	CIE Marks	SEE Marks	Total Marks	Exam Hrs.
1	PC	24 TPE IS1	**Internship**	**ME**	-	-	-	**9**	100	-	100	-
2	PC	24 TPE NE1	**Online Courses:NPTEL/MOOC/Swayam**	**ME**				**3**	50	50	100	
3	PC	24 TPE PW1	**Project Phase-I**	**ME**	-	-	-	**8**	50	-	50	-
L: Lecture, T-Tutorial, P-Practical/Drawing, CIE: Continuous Internal Evaluation, SEE: Semester End Examination				**Total**	-	**-**	-	**20**	**150**	**50**	**150**	**-**

4th SEMESTER MTech

SI No	Course Code		Course Title	Teaching Dept.	L	T	P	Credits	CIE Marks	SEE Marks	Total Marks	Exam Hrs.
1	PC	24 TPE PW2	**Professional Work Phase-II**	**ME**	-	-	-	**20**	100	200	300	-
2 Paper Publications is compulsory (Conference/Journal)												
L: Lecture, T-Tutorial, P-Practical/Drawing, CIE: Continuous Internal Evaluation, SEE: Semester End Examination				**Total**	-	**-**	-	20	**100**	**200**	300	**-**
Credits Distribution: 1st Sem=24, 2nd Sem =24, 3rd Sem=20, 4th Sem=20, Total Credits=24+24+20+20=88 Credits												

Total Credits: 24+24+20+20=88

Department: Mathematics			**Semester:**	**I**
Subject:Applied Mathematics (M.Tech) (Common to: Electrical -CAID and Mechanical (TPE)				
Subject Code:	**24TPE101/24CAI101**		**L – T – P - C:**	**4–0–0–4**

Sl. No	Course Objectives
1	Acquaint with principles of linear algebra, probability theory and Numerical methods.
2	Apply the knowledge of linear algebra, probability theory and random process in the applications of electronics and communication engineering sciences.
3	To understand the concepts of the stochastic process of a statistic and estimation of parameters arising in engineering field.
4	To study the queuing models and sampling distributions.

Unit	Description	Hrs
I	**Linear Algebra-I** Introduction to vector spaces and sub-spaces, definitions, illustrative examples and simple problems. Linearly independent and dependent vectors-definition and problems. Basis of vector space. Linear transformations- definition, properties and problems. Matrix form of linear transformations-Illustrative examples.	**10**
II	**Linear Algebra-II** **System of Linear Algebraic Equations and Eigen Value Problems:** Gauss – Seidal Iterative method. Eigen value problems- Finding all the Eigen values and Eigen vectors, Gerschgorial circle,Computation of Eigen values and Eigen vectors of real symmetric matrices by QR decomposition, singular value decomposition.	**10**
III	**Numerical Methods:** Solution of algebraic and transcendental equations-Newton- Raphson method for simple roots and multiple roots. Rate of	**10**

	convergence of Newton- Raphson method. System of non-linear equations by Newton- Raphson method. Polynomial equations by Birge – Vieta method and Bairstow method.	
IV	**Solution of Simultaneous Linear Algebraic Equations:** Introduction, Engineering Applications, Basic Ill-Conditioned Equations. Graphical Interpretation of the Solution, Solution Using Cramer's Rule, LU Decomposition Method, Relaxation Methods.	**11**
V	**Probability Theory** Review of basic probability theory. Definitions of random variables and probability distributions, probability mass and density functions, expectation, moments, central moments, characteristic functions, probability generating and moment generating functions-illustrations. Binomial, Poisson, Exponential, Gaussian and Rayleigh distributions.	**11**

Course Outcomes:

Course outcome	Descriptions
CO1	Acquaint with principles of linear algebra, probability theory and Numerical methods.
CO2	Adequate exposure to learn alternative methods and analyze mathematical problems to determine the suitable numerical techniques.
CO3	Use the concepts of interpolation, eigen value problem techniques for mathematical problems arising in various fields.
CO4	To study the concept of probability distributions with probability generating functions

Course Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2												
CO2	3	1	1											

CO3	3	1	1	1										
CO4	3	2	1	1										

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Numerical Methods for Scientific and Engineering Computations	M K Jain, S R K Iyengar and R K Jain,	New Age International, 2004.
2	Higher Engineering Mathematics	B S Grewal	41st Edition, Khanna Publishers, 2011.

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Numerical Solution of Differential Equations	M K Jain	2nd Edition, New Age International, 2008
2	Linear Algebra and its Applications	David C.Lay, Steven R. Lay and J.J.McDonald	5th Edition, Pearson Education Ltd., 2015

SYLLABUS FOR THE ACADEMIC YEAR – 2024 - 2025

I Semester: M.Tech (TPE)

Sub.Code: 24 TPE 12	**ADVANCED POWER PLANT CYCLES**	**L-T-P-C: 4-0-0-4**

Course Objectives:

1	To understand the various power plant cycle and their working principles.
2	To study the working principles of different components of power plant.
3	To understand concepts of power generation by nuclear power plant.
4	To study the concept of gas turbine plant.

Course Outcomes:

CO1	Distinguish the various power plant cycle and their working principles.
CO2	Describe the working principles of different components of power plant.
CO3	Explain the concepts of power generation by nuclear power plant.
CO4	Illustrate the concept of gas turbine plant.

Unit	Description	Hours
I	**Analysis of Steam Cycle**: carnot cycle, limitations of carnot cycle, Rankine Cycle – performance – thermodynamic analysis of cycles, cycle improvements-reheating, Regeneration, regeneration feed water heating, feed water heaters, typical layout of steam power plant. Numerical problems.	**10**
II	**Gas Turbine Cycles:** optimization – thermodynamic analysis of cycles – cycle improvements– multi spool arrangement. Intercoolers, re-heaters, regenerators –operation and performance – layouts, numerical problems.	**10**
III	**Combined Cycle Power Generation**: Flaws of steam as working fluid in power cycle, characteristics of ideal working fluid for vapour power cycle, Binary vapour cycles, coupled cycles, combined cycle plants, Gas turbine-steam power plant and advantages of combined cycle power generation. (Except numerical)	**10**
IV	**Overview of Nuclear Power Plants**: Principles of release of nuclear energy fusion and fission reactions. Nuclear fuels used in the reactors. Multiplication and thermal utilization factors. Elements of the nuclear reactor, Moderator, control rod, fuel rods, coolants. Brief description of reactors of the following types pressurized water reactor, boiling water reactor sodium graphite reactor, Fast breeder reactor, Homogeneous graphite reactor and gas cooled reactor, Radiation hazards, Shielding's, Radioactive waste disposal.	**12**

V	**Economics of power generation :** Choice of site for power station, load estimation, load duration curve, load factor, capacity factor, use factor, diversity factor, demand factor effect of variable of variable load an power plant, selection of the number and size of units. Cost of energy production. Selection of plant and generating equipment, performance and operating characteristics of power plants, tariffs for electrical energy	**10**

Reference Books:

Sl. No	Title	Author	Volume and Year of Edition
1	**Power Plant Engineering**	P.K. Nag,	Tata McGraw-Hill Publications
2	**Power Plant Engineering**	M.M. EI-Wakil	McGraw- Hill Publications
3	**Power plant engineering**	R K Rajput	Lakshmi publication

SYLLABUS FOR THE ACADEMIC YEAR – 2024 - 2025		
I Semester: M.Tech (TPE)		
Sub.Code: 24 TPE 13	**ADVANCED FLUID MECHANICS**	**L-T-P-C: 4-0-0-4**

Course Objectives:

1	To study the concepts fluid flow and their governing equations
2	To understand the concepts in the analysis of fluid flow problems in laminar and Turbulent flows
3	Adequate exposure to learn formulate and solve one dimensional incompressible and compressible fluid flow problems
4	To analyze one dimensional incompressible and compressible fluid flow Problems

Course Outcomes:

CO1	Basic concepts fluid flow and their governing equations
CO2	Understand the concepts in the analysis of fluid flow problems in laminar and Turbulent flows
CO3	Formulate and solve one dimensional incompressible and compressible fluid flow problems
CO4	Analyze one dimensional incompressible and compressible fluid flow Problems

Unit	Description	Hours
I	**Introduction and Kinematics of Fluids**: Regimes in mechanics of fluids; fluid properties, Fluid statics – equilibrium of a fluid element, application to manometry, Problems. **Equations of Fluid Flow**: Integral form: Reynolds transport theorem, Conservation equations for mass, momentum and energy - integral forms, Problems.	14
II	**Governing Equations for Fluid Flow**: Differential form: Conservation equations for mass, momentum and energy - differential forms, Euler's equations of motion, integration along the stream line; integration of steady irrotational motion; integration for two dimensional unsteady flow, Problems. **Inviscid Incompressible Flows (Potential Flows):** Elementary Plane-flow solutions - uniform flow, source and sink flow, Superposition of plane flow solutions - Rankine half-body, doublet, flow past a circular cylinder with circulation, Aerofoil theory.	13
III	**Exact solutions of N-S Equations and Mechanics of Laminar Flow:** Introduction; Laminar and turbulent flows; viscous flow at different Reynolds number -; laminar plane Poiseuille flow; stokes flow; flow through a concentric	06

	annulus, Problems.	
IV	**Boundary Layer Theory:** Introduction; Boundary layer equations; displacement and momentum thickness, shape factor; flow over a flat plate – similarity transformation, integral equation for momentum and energy ; skin friction coefficient and; separation of boundary layer; critical Reynolds number; control of boundary layer separation, Problems.	**07**
V	**Mechanics of Turbulent Flow:** structure and origin of turbulent flow - Reynolds, average concept, Reynolds equation of motion; zero equation model for fully turbulent flows; k-Є and other turbulence models; turbulent flow through pipes; losses in bends, valves etc; analysis of pipe network - Hard cross method, Problems. **Compressible Flows**: The speed of sound, Adiabatic and isentropic steady flow, Isentropic flow with area changes, The normal shock wave, Operation of converging and diverging nozzles, Prandtl-Meyer expansion waves. Problems.	**12**

Reference Books:

Sl. No	Title	Author	Volume and Year of Edition
1	**Foundations of fluid mechanics**	S.W. Yuan	Prentice Hall of India, 1976
2	**Fluid Mechanics**	F.M. White	McGraw-Hill publications, 2007

SYLLABUS FOR THE ACADEMIC YEAR – 2024 - 2025			
I Semester: M.Tech (TPE)			
Sub.Code: 24 TPE 14	**COMBUSTION ENGINEERING SCIENCE**		**L-T-P-C: 3-0-0-3**
Course Objectives:			
1	To understand the basic thermodynamic concepts for combustion phenomena		
2	To apply the concept of flam flow mechanism in combustion process.		
3	To acquire knowledge of adiabatic flame temperature in the design of combustion devices.		
4	To study phenomenon of flame stabilization in laminar and turbulent flames		
Course Outcomes:			
CO1	Understand the basic thermodynamic concepts for combustion phenomena		
CO2	Apply the concept of flam flow mechanism in combustion process.		
CO3	Knowledge of adiabatic flame temperature in the design of combustion devices.		
CO4	Identify the phenomenon of flame stabilization in laminar and turbulent flames		

Unit	Description	Hours
I	**Introduction of combustion of fuel:** Combustion Stoichiometry and equivalence ratio, Dew point of Products, Flue gas analysis, **Concept of equilibrium and Fundamentals of chemical kinetics and:** Gibbs free energy, Rate of reaction, Reaction order and Molecualrity, Complex reaction, Chain Reaction, Theories of Rate of Reaction,.	**08**
II	**Thermodynamics of Combustion:** Combustion Process and the first law, Energy balance of chemical reaction, adiabatic flame temperature, Equilibrium Composition of gaseous mixture, Calculation of equilibrium composition and Temperature **Laminar flame propagation and burning velocity:** Premixed flames, Structure of laminar flame and their theories of laminar flame propagation, Methods of observing flame front and measuring burning velocity, Factors affecting burning velocity.	**08**
III	**Turbulent flame propagation, Flame stability and Diffusion flames** **Turbulent flame propagation**:-Turbulent burning velocity, Factors affect turbulent burning velocity, Structure and theories of turbulent flame, **Flame stability, Diffusion flames** flame stabilization of open burner, Characteristics stability diagram and Mechanisms of flame stabilization, flame stretch theories and flame stabilization by eddies, theories of diffusion flames	**08**

IV	**Combustion of liquid and solid fuels**- Combustion of liquid fuels and fuel droplets, Shape of flame surface during burning of droplet with natural convection, droplet interference during burning, diffusion of flame in spray combustion, combustion of coal, burning time of fuel particles.	**08**
V	**Combustion Application:** Coal burning equipment, Pulverized Coal burners, Cyclone Burners oil and gas burners, Combustion in IC engine, Rocket engines, gas turbine and jet engines	**08**

Reference Books:		
Title	**Author**	**Volume and Year of Edition**
Fuels and combustion	S.P. Sharma and Chandra Mohan	Tata McGraw-Hill, 1984.
Energy. Combustion and Environment	N.A. Chigier	McGraw-Hill, 1981

SYLLABUS FOR THE ACADEMIC YEAR – 2024 - 2025		
I Semester: M.Tech (TPE)		
Sub.Code: 24 TPE LB1	**THERMAL ENGINEERING LABORATORY**	**L-T-P-C: 0-0-3-1.5**

Course Objectives:

1	To able to identify and select the equipment to conduct the experiments related to heat engine lab
2	To able to demonstrate the procedure for conduction of experiments.
3	To able to identify and select the equipment to conduct the experiments related to heat transfer lab
4	To analyze the data collected and interpret the results.

Course Outcomes:

CO1	Identify and select the equipment to conduct the experiments related to heat engine lab
CO2	Demonstrate the procedure for conduction of experiments.
CO3	Identify and select the equipment to conduct the experiments related to heat transfer lab
CO4	Analyze the data collected and interpret the results.

Expt.	**Description**
1.	Performance testing of 4-stroke Diesel engine with a rope brake dynamometer. Determination of BP, IP, mechanical efficiency, brake and indicated thermal efficiencies, and brake and indicated specific fuel consumption.
2.	Heat balance sheet preparation for a 4-stroke Diesel engine.
3.	Combustion characteristics of a 4-stroke Diesel engine. Determination of mass fraction burnt heat release rate, overall combustion duration, and ignition delay period from P-Theta diagram
4.	Performance testing of 4-stroke petrol engine with a rope brake dynamometer. Determination of BP, IP, mechanical efficiency, thermal efficiencies, and specific fuel consumption.
5.	Heat balance sheet preparation for a 4-stroke Diesel engine
6.	Combustion characteristics of a 4-stroke Diesel engine. Determination of mass fraction burnt, heat release rate, overall combustion duration, and ignition delay period from P-Theta diagram

7.	Determination of COP for vapor compression refrigeration.
8.	Determination of natural convection heat transfer coefficient for a hollow vertical pipe.
9.	Determination of forced convection heat transfer coefficient for air flow through a horizontal pipe.
10.	Determination of Stefan-Boltzmann constant for radiation heat transfer.
11.	Determination of emissivity of a gray body.

PROFESSIONAL ELECTIVE-I

I Semester: M.Tech (TPE)-Professional Elective		
Professional Elective-I		
1	24TPE151	Energy Conservation and Management
2	24TPE152	Thermal Power Station
3	24TPE153	Modeling & Simulation of Thermal Systems

SYLLABUS FOR THE ACADEMIC YEAR – 2024 - 2025		
I Semester: M.Tech (TPE)		
Sub.Code: 24TPE151	**Energy Conservation and Management**	**L-T-P-C: 3-0-0-3**

Course Objectives:

1	To able to understand the various energy conservation and improvement techniques.
2	To able to illustrate the Energy scenario.
3	To study the principles of energy management to improve the Performance of systems.
4	To able to Assess energy projects on the basis of economic and financial criteria.

Course Outcomes:

CO1	Understand the various energy conservation and improvement techniques.
CO2	Illustrate the Energy scenario.
CO3	Employ the principles of energy management to improve the Performance of systems.
CO4	Assess energy projects on the basis of economic and financial criteria.

Unit	Description	Hours
I	**Energy Management Principle:** General energy problem, Energy uses patterns and scope of conversion. Need, Organizing and managing an energy management program. **Energy Auditing and Economic Analysis:** Elements and concepts, Type of energy audits instruments used in energy auditing. Cash flows, Time value of money, Formulae relating present and future cash flows- single amount, uniform series.	12
II	**Financial appraisal methods:** Pay back periods, net present value, and benefit cost ratio, internal rate of return and Life cycle cost / benefits. **Thermodynamics of energy conservation:** Energy conservation in Boilers and furnace, Energy conservation in stream and condensate system.	12
III	**Cogeneration Concepts**: Types & evaluation of a cogeneration system	04
IV	**Waste Heat Recovery:** Potential, benefit, waste heat recovery equipments. Space Heating, Ventilation Air Conditioning (HVAC) and water heating of building, Transfer of heat, space heating methods, Ventilation and air conditioning, Heat pumps, Insulation, Cooling load, Electric water heating systems, Electric energy conversation methods.	06
V	**Industrial Insulation:** Insulation materials, insulation selection, Economical thickness of insulation. Industrial Heating: Heating by indirect resistance, direct	06

	resistance heating (salt bath furnace), Heat treatment by induction heating in the electric furnace industry. Energy conservation in Electric Utility and Industry: Energy cost and two -part tariff, Energy conservation in utility by improving load factor, Load curve analysis, Energy efficient motors, Energy conservation in illuminating system, Importance of power factor in energy conservation - Power factor and Improvement	

Reference Books:

Title	Author	Volume and Year of Edition
Electrical Energy Utilization and Conservation	S.C. Tripathy	Tata McGraw-Hill, 1981.
Energy management handbook	Wayne C. Turner	CRC Press Publications, 2004.
Industrial Energy Conversation	D.A. Reay	Pergamon Press

SYLLABUS FOR THE ACADEMIC YEAR – 2024 - 2025		
I Semester: M.Tech (TPE)		
Sub.Code: 24TPE152	**THERMAL POWER STATION**	**L-T-P-C: 3-0-0-3**

Course Objectives:

1	To study the working principle, operation and maintenance of a various steam generators.
2	To able to identify the arrangements of different flow systems their operation and maintenance.
3	To able to illustrate the impact of thermal power plant exhaust on environment.
4	To able to estimate the working expenses, current scenario and trends in power generation

Course Outcomes:

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

Unit	Description	Hours
I	**Steam Generator and Auxiliaries:** High pressure boilers, classification, schemes, circulation, nature of fuels and its influence on design, furnaces, PF burners, PF milling plant, oil and gas burner types and location, arrangement of oil handling plant.	06
II	**Waste heat recovery systems:** Furnace circuit, steam side and waterside corrosion, pressure parts, super heater, re-heater, and economizer, de-super heater, air heater, on-load cleaning of boilers’	04
III	**Dust Extraction Equipment:** Bag house, electrostatic precipitator, draught systems, FD, ID and PA fans, chimneys, flue and ducts, dampers, thermal insulation and line tracing, FBC boilers and types., waste heat recovery boilers. **Feed Water system:** Impurities in water and its effects, feed and boiler water corrosion, quality of feed water, boiler drum water treatment and steam purity, water treatment, clarification, demineralization, evaporation and reverse osmosis plant.	10
IV	**Circulating water system:** Introduction, System classification, the circulation system, Wet-Cooling towers, Wet-cooling tower calculations, Dry cooling towers, Dry-cooling towers and plant efficiency and economics, wet-dry cooling towers, cooling-tower icing, Cooling lakes and ponds, Spray ponds and canals. **Operation and Maintenance of Steam Generators and auxiliaries:** Pre	10

	commissioning activities, Boiler start up and shut down procedures, emergencies in boiler operation, Maintenance of Steam generator and auxiliaries.	
V	**Performance:** Boiler efficiency and optimization, coal mill, fans, ESP. **EIA study:** Pollutants emitted, particulate matter, SOx and NOx and ground level concentration, basic study of stack sizing.	**10**

Reference Books:

Title	**Author**	**Volume and Year of Edition**
Power Plant Engineering	P.K. Nag	Tata McGraw-Hill, 1981.
Power Plant Engineering	M. EI-Wakil	Tata McGraw-Hill
Power Plant Engineering	R.K.Rajput	Laxmi Publications 3rd edition

SYLLABUS FOR THE ACADEMIC YEAR – 2024 - 2025		
I Semester: M.Tech (TPE)		
Sub.Code: 24TPE153	**MODELING & SIMULATION OF THERMAL SYSTEMS**	**L-T-P-C: 3-0-0-3**

Course Objectives:

1	To study basic principles and concepts underlying in modeling and simulation Techniques.
2	To able to optimize the design of thermal systems.
3	To able to develop representational modes of real processes and systems
4	To able to generate suitable modelling techniques to compute the performance

Course Outcomes:

CO1	Explain the basic principles and concepts underlying in modeling and simulation Techniques.
CO2	Optimize the design of thermal systems.
CO3	Develop representational modes of real processes and systems
CO4	Generate suitable modelling techniques to compute the performance

Unit	Description	Hours
I	**Principle of Computer Modeling and Simulation:** Monte Carlo simulation, Nature of computer modeling and simulation, limitations of simulation, areas of application	**06**
II	**System and Environment:** components of a system —discrete and continuous systems. Models of a system-a variety of modeling approaches.	**06**
III	**Random Number Generation:** technique for generating random numbers —mid square method- The mid product method- constant multiplier technique-additive congruential method —linear congruential method —tests for random numbers —the kolmogorov-simrnov test-the Chi-square test. **Random Variable Generation:** inversion transform technique- exponential distribution- uniform distribution-weibul distribution empirical continuous distribution- generating approximate normal varieties —Erlang distribution	**08**
IV	**Empirical Discrete Distribution:** Discrete uniform distribution — poission distribution- geometric distribution- acceptance-rejection technique for poission distribution-gamma distribution. **Design And Evaluation Of Simulation Experiments**: variance reduction techniques-antithetic variables- variables-verification and validation of	**10**

	simulation models.	
V	**Discrete Event Simulation**: concepts in discrete-event simulation, manual simulation using event scheduling, single channel queue, two server queue simulation of inventory problem. **Introduction to GPSS:** Programming for discrete event systems in GPSS, case studies.	**10**

Reference Books:

Sl. No	Title	Author	Volume and Year of Edition
1	**Discrete event system simulation -**	Jerry Banks & John S Carson II,	Prentice Hall Inc, 1984.
2	**Systems simulation**	Gordon G	Prentice Hall Of India Ltd,1991.
3	**System simulation with digital Computer**	Narsingh Deo	Prentice Hall Of India Ltd,1979

PROFESSIONAL ELECTIVE-II

Professional Elective-II		
1	24TPE161	Theory of IC Engines
2	24TPE162	Refrigeration and Air Conditioning
3	24TPE163	Experimental Methods in Thermal Power Engineering

SYLLABUS FOR THE ACADEMIC YEAR – 2024 - 2025		
I Semester: M.Tech (TPE)		
Sub.Code: 24TPE161	**THEORY OF IC ENGINES**	**L-T-P-C: 3-0-0-3**

Course Objectives:

1	To study different Fuel-air and actual cycles.
2	To able to demonstrate the different types of injection and carburetor systems
3	To able to formulate the flow and combustion phenomenon for modeling
4	To able to identify the various types of emissions, noise and their control systems

Course Outcomes:

CO1	Distinguish different Fuel-air and actual cycles.
CO2	Demonstrate the different types of injection and carburetor systems
CO3	Formulate the flow and combustion phenomenon for modeling
CO4	Identify the various types of emissions, noise and their control systems

Unit	Description	Hours
I	**Engine Design and Operating Parameters:** Engine characteristics, geometrical properties of reciprocating engines, brake torque, indicated work, road load power, m.e.p., s.f.c. and efficiency, specific emissions and emission index, relationships between performance parameters, Engine design and performance data. **Alternate fuels for I.C engines:** Vegetable oils, alcohol's, L.P.G, C.N.G, properties, emission characteristics, F/ A ratio .	09
II	**Ideal models for engine cycles:** Thermodynamic relation for engine process, Ideal Cycle analysis, fuel-air cycle analysis, over expanded engine cycles, Availability analysis of engine processes, comparison with real engine cycle **SI Engines fuel metering, manifold phenomena:** S.I. Engine mixture requirements, carburetors, fundamentals and design, fuel injection systems, feed back systems, flow past throttle plate, flow in in-take manifold	11
III	**Combustion in IC Engines:** Combustion in SI Engines – Flame front propagation, flame speed, rate of pressure rise, knock in SI engines; combustion in CI engines – ignition delay period, rapid and controlled combustion, factors affecting delay period, knock in CI engines	06
IV	**Engine Operating Characteristics:** Engine performance parameters, Effect of spark-timing, Mixture composition, load and speed and compression ratio on engine performance, efficiency and emissions, SI engine combustion chamber design and optimization strategy, Testing of SI engine.	06

V	**Instrumentation:** Pressure measurement in engines, recording pressure and crank angle diagram, measurement of pollutants. **Engine emissions and their control:** Air pollution due to IC engines, Euro norms I & II, engine emissions, emission control methods – thermal converters, catalytic converters, particulate traps, Ammonia injection systems, exhaust gas re-circulation.	**08**

Reference Books:

Title	**Author**	**Volume and Year of Edition**
Internal Combustion Engines	V. Ganesan	Tata McGraw-Hill Publications.
IC Engines fundamentals	John B. Heywood	McGraw-Hill Publications
Internal Combustion Engines: Applied Thermo sciences	C.R. Fergusan	John Wiley & Sons

SYLLABUS FOR THE ACADEMIC YEAR – 2024 - 2025		
I Semester: M.Tech (TPE)		
Sub.Code: 24TPE162	**REFRIGERATION AND AIR - CONDITIONING**	**L-T-P-C: 3-0-0-3**

Course Objectives:

1	To study the concepts of refrigeration and air-conditioning process and systems.
2	To able to employ the theoretical principles to simple, complex vapour compression and vapour absorption refrigeration systems.
3	To able to understand conventional and alternate refrigerants and their impact on environment.
4	To able to heat load calculation to design the air-conditioning systems

Course Outcomes:

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

Unit	Description	Hours
I	**Method of Refrigeration and Non-conventional refrigeration system:** Ice refrigeration, evaporative refrigeration, refrigeration by expansion of air, refrigeration by throttling of gas, Vapor refrigeration system, steam jet refrigeration system, refrigeration by using liquid using liquid gases, dry ice refrigeration, types of refrigerants, properties of refrigerants, thermoelectric refrigeration, vortex refrigeration, cooling by adiabatic demagnetization, pulse tube refrigeration.	**06**
II	**Air refrigeration system:** Bell Coleman air refrigerator, advantages and disadvantages of air refrigeration system, necessity of cooling the aero plane, factors considered in selecting the refrigeration system for aero plane, simple cooling with simple evaporative type aero plane air conditioning, boot strap and boot strap evaporative type, regenerative type, reduced ambient type, comparison of different systems, actual air conditioning system with control, limitations, merits and comparisons.	**06**
III	**Vapor compression refrigeration system:** Simple vapor refrigeration system, T-s, h-s, p-h diagrams for vapor compression refrigeration system, wet versus dry compression, vapor compression refrigeration systems with multiple evaporators and compressors. **Absorption refrigeration system:** Basic-absorption system, actual ammonia absorption system, Electrolux refrigeration system,	**12**

	lithium bromide absorption refrigeration system, analysis of ammonia refrigeration system, comparison of compression and absorption refrigeration system	
IV	**Psychometry:** Psychometry and psychometric properties, psychometric relations, psychometric chart, psychometric processes, requirements of comfort air conditioning, comfort chart, design consideration, summer air conditioning system, winter air conditioning. **Cooling load calculations and design of air conditioning system:** Different heat sources, conduction heat load, radiation load of sun, occupants load, equipment load, infiltration air load, miscellaneous heat sources, fresh air load, design of air conditioning system, bypass factor consideration, effective sensible heat factor, cooling coils and dehumidifying air washers.	**08**
V	**Air conditioning systems:** Air conditioning systems central station air conditioning system, unitary air conditioning system, direct air conditioning system, self contained air conditioning units, direct expansion system, all eater system, all air system air water system , arrangement of the components of some air conditioned systems used in practice, factory air conditioning. **Refrigeration and air conditioning equipments: R**efrigeration equipments-Compressors, condensers and cooling towers, evaporators, expansion devices, electric motors air conditioning equipments- air cleaning and air filters, humidifiers, dehumidifiers from different reputed companies, fans and blower.	**08**

Reference Books:

Sl. No	Title	Author	Volume and Year of Edition
1	**A Course in refrigeration and Air- Conditioning**	Arora and Domkundawar	Danpat Rai & Co Publications.
2	**Basic Refrigeration and Air Conditioning**	P.N. Ananthanarayanan	McGraw-Hill Publications .
3	**Refrigeration & Air Conditioning**	Manohar Prasad.,	New Age International Publications.

SYLLABUS FOR THE ACADEMIC YEAR – 2024 - 2025		
I Semester: M.Tech (TPE)		
Sub.Code: 24TPE163	**EXPERIMENTAL METHODS IN THERMAL POWER ENGINEERING**	**L-T-P-C: 3-0-0-3**

Course Objectives:

1	To understand the concepts of errors in measurements, statistical analysis of data, regression analysis, correlation and estimation of uncertainty.
2	To study the working principles in the measurement of field and derived quantities.
3	To able to examine sensing requirements for measurement of thermo-physical properties,
4	To understand the radiation properties of surfaces, and vibration.

Course Outcomes:

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,
CO4	Understand the radiation properties of surfaces, and vibration.

Unit	Description	Hours
I	**Introduction:** Basic concepts of measurement methods, single and multi point measurement Min space and time. Processing of experimental data, curve fitting and regression analysis. Data Acquisition systems: Fundamentals of digital signals and their transmission, A/D-and D/A converters, Basic components of data acquisition system. Computer interfacing of digital instrument and data acquisition systems; Digital multiplexes, Data acquisition board (DAQ), Digital image processing fundamentals.	**06**
II	**Design and Construction of Experimental facilities:** wind tunnel, general test rigs, Test cells for flow visualization and temperature mapping.	**06**
III	**Modeling and Simulation of Measurement System:** Lumped analysis, first order and second order systems: Frequency response and time constant calculation. Response of a generalized instrument to random data input, FFT analysis. **Temperature Measurement:** Measurement Design, Construction and Analysis of liquid and gas thermometers, resistance thermometer with wheat stone	**08**

	bridge, Thermo-electric effect, Construction, testing and calibration of thermocouples and thermopiles, Analysis of effect of bead size and shielding on time constant and frequency response, characteristics of thermocouple, pyrometers, radiation thermometers	
IV	**Interferometry & Humidity measurement:** interferometers, Humidity measurement: Conventional methods, electrical transducers, Dunmox humidity and microprocessor based dew point instrument, Calibration of humidity sensors. **Flow and Velocity Measurement:** industrial flow measuring devices, design, selection and calibration, velocity measurements, pitot tubes, yaw tubes, pitot static tubes; frequency response and time constant calculation. Hot-wire anemometer; 2d/3d flow measurement and turbulence measurement, Laser application in flow measurement, Flow visualization techniques, Combustion photography.	**12**
V	**Measurement of Pressure, Force, and Torque:** Analysis of liquid manometer, dynamics of variable area and inclined manometer, Pressure transducers, Speed and torque measurement: r speed and torque measurement of rotating system. **Air Pollution sampling and measurement;** Units for pollution measurement, gas sampling technique s, particulate sampling technique, gas chromatography.	**08**

Reference Books:

Sl. No	Title	Author	Volume and Year of Edition
1	**Experimental Methods for Engineers**	J.P. Holman	McGraw-Hill Publications.
2	**Mechanical Measurements**	Beckwith M.G., Marangoni R.D. and Lienhard J.H.,	Pearson Education.
3	**Measurements systems-Application and Design**	E.O. Doebelin, Publications.	Tata McGraw-Hill.

II- Semester

SYLLABUS FOR THE ACADEMIC YEAR – 2024 - 2025		
II Semester: M.Tech (TPE)		
Sub.Code: 24 TPE 21	**HEAT TRANSFER**	**L-T-P-C: 4-0-0-4**

Course Objectives:

1	To understand different modes of heat transfer with both physics and the mathematical concept
2	To understand the concepts of radiation heat transfer for enclosure analysis.
3	To study the concepts of Boundary layer.
4	To study free and forced convection problems in real time applications

Course Outcomes:

CO1	Describe the different modes of heat transfer with both physics and the mathematical concept.
CO2	Use the concepts of radiation heat transfer for enclosure analysis.
CO3	Explain the concepts of Boundary layer.
CO4	Describe the free and forced convection problems in real time applications

Unit	Description	Hours
I	**Introduction and one-dimensional heat transfer:** The modes of heat transfer, the laws of heat transfer, problems Heat conduction in solids: Simple steady state problems in heat conduction, concept of thermal resistance, the critical radius problem, the differential equation of heat conduction, heat generation.	10
II	**Extended surfaces** - Fins, other techniques for solving heat conduction problems. **Transient heat conduction:** unsteady state processes and Transient heat conduction, problems.	12
III	**Heat transfer by forced convection:** The differential equation of heat convection, laminar flow heat transfer in circular pipe, turbulent flow heat transfer in a pipe, the thermal boundary layer, heat transfer in laminar flow over a flat plate, the integral method, analogy between heat and momentum transfer, heat transfer in turbulent flow over a flat plate, flow across a cylinder, flow across a bank of tubes, problems. **Heat transfer by natural convection:** Natural convection heat transfer from a vertical plate, correlations for a horizontal cylinder and a horizontal plate, correlations for enclosed spaces, problems.	12
IV	**Heat exchangers:** Types of heat exchangers, direct transfer type of heat	10

	exchangers, classification according to flow arrangement, fouling factor, logarithmic mean temperature difference, the effectiveness-NTU method Compact heat exchangers. **Condensation and boiling:** Film and drop condensation, film condensation on a vertical plate, condensation on horizontal tubes, bank of tubes, effect of superheated vapor and of non-condensable gases, types of boiling: correlations in pool boiling heat transfer, forced convection boiling, problems.	
V	**Thermal radiation:** Basic concepts, emission characteristics and laws of black body radiation, radiation incident on a surface, solid angle and radiation intensity, heat exchange by radiation between two black surface elements, heat exchange by radiation between two finite black surfaces, radiant heat exchange in an enclosure having black surfaces, heat exchange by radiation between two finite parallel diffuse-gray surfaces, heat exchange by radiation in an annular space between two infinitely long concentric cylinders , radiant heat exchange in an enclosure having diffuse gray surfaces, problems.	**08**

Reference Books:

Sl . No	**Title**	**Author**	**Volume and Year of Edition**
1	**Heat Transfer – A Basic Approach**	Ozisik M.N	McGraw-Hill Publications.1985
2	**Heat Transfer**	J.P. Holman	McGraw-Hill Publications. [illegible]
3	**Principles of Heat Transfer**	Frank Kreith& M. S. Bohn.,	Thomson Publications, 2001

SYLLABUS FOR THE ACADEMIC YEAR – 2024 - 2025		
II Semester: M.Tech (TPE)		
Sub.Code: 24 TPE 22	**TURBOMACHINES**	**L-T-P-C: 4-0-0-4**

Course Objectives:

1	To study the working principles of Gas and steam turbines nozzle and diffusers.
2	To study the principles of thermodynamic concept to determine the performance of
3	To able to Illustrate the concepts of flow over the Impulse-Reaction Turbine Blades.
4	To study the Jet and Rocket Propulsion

Course Outcomes:

CO1	Describe the working principles of Gas and steam turbines nozzle and diffusers.
CO2	Explain the principles of thermodynamic concept to determine the performance of steam and gas turbines.
CO3	Illustrate the concepts of flow over the Impulse-Reaction Turbine Blades.
CO4	Explain Jet and Rocket Propulsion

Unit	Description	Hours
I	**Nozzles and diffusers:** Introduction types of nozzles, types of Diffusers, Equation of Continuity Sonic Velocity and Mach Numbers, The Steady Flow Energy Equation in Nozzles, Gas Nozzles The Momentum Equation for the flow Through Steam Nozzles, Entropy Changes with friction, Nozzle Efficiency, The Effect of Friction on the Velocity of steam Leaving the Nozzles, Diffusion Efficiency, shape of Nozzle for Uniform Pressure Drop, Mass of Discharge of Critical Pressure in Nozzle Flow or Chocked Flow, Physical Explanation of Critical Pressure, Maximum Discharge of Saturated Steam, Maximum Discharge of Steam initially Superheated, Critical Pressure Ratio for Adiabatic and Frictionless Expansion of Steam from Ratio for Adiabatic and Frictionless Expansion of Steam from a given initial Velocity, Total or Stagnation Enthalpy and Pressure, General Relationship Between or Area Velocity and pressure in Nozzle Flow .	**12**
II	**Steam Turbines Types:** Principal of operation of turbine, Comparison of Steam Engines and Turbines, Classifications of Steam Turbine, The Simple Impulse Turbine, Compounding of Impulse Turbine, Pressure Compounded	**12**

	Impels Turbine, Simple Velocity –Compounded Impulse Turbine, Pressure Velocity –Compounded Impulse Turbine, Impulse –Reaction Turbine, Combination Turbines, Difference between Impulse and Reaction Turbines. **Flow of Steam through Impulse Turbine Blades** : Velocity Diagram for Impulse Turbines, Combination of Vector Diagram , Forces on the Blade and Work done by Blades, Blade or Diagram Efficiency ,Axial Thrust or end thrust on the rotor, Gross Stage Efficiency, Energy Converted heat by blade friction, Influence of ratio of blade speed to steam speed on blade efficiency in single stage impulse turbine, Efficiency of multistage impulse turbine with single row wheel, Velocity diagram for three row velocity compound wheel, Most economical ratio of blade speed for a two row velocity compounded impulse wheel, Impulse blade suctions, Choice of blade angle, Inlet blade angles, Blade heights in velocity compounded impulse turbine.	
III	**Flow of Steam Through Impulse-Reaction Turbine Blades:** Velocity diagram, degree of reaction, impulse- reaction turbine with similar blade section and half degree reaction turbine, height of reaction turbine blading, effect of working steam on the stage efficiency of Parson's turbine, operation of impulse blaring with varying heat drop or variable speed, impulse- reaction turbine section.	**08**
IV	**State Point Locus Reheat Factor and Design Procedure:** Introduction, stage efficiency of impulse turbines, state point locus of an impulse turbine, reheat factor, internal and other efficiencies, increase in isentropic heat drop in a stage due to friction in proceeding stage, correction for terminal velocity, reheat factor for an expansion with the uniform adiabatic index and a constant stage efficiency, correction of reheat factor for finite number of stages, design procedure of impulse turbine, design procedure for impulse- reaction turbines.	**08**
V	**Jet and Rocket Propulsion :** The ram jet engine, pulse jet engine, turbo prop engine, turbo jet engine, thrust equation, specific thrust, principles of rocket propulsion, ideal chemical rocket, advantages of liquid over solid propellants, free radical propulsion, nuclear propulsion, electro dynamics propulsion, photon propulsion.	**12**

Reference Books:

Sl. No	Title	Author	Volume and Year of Edition
1	**Steam and Gas Turbines**	R. Yadav,	Central Publishing House, Allahabad
2	**Gas Turbine Theory**	H.I.H. Saravanamuttoo,	G.F.C. Rogers & H Cohen Pearson Education.
3	**Gas Turbines**	V. Ganesan,	Tata McGraw-Hill Publications

SYLLABUS FOR THE ACADEMIC YEAR – 2024 - 2025		
II Semester: M.Tech (TPE)		
Sub.Code: 24 TPE 23	**FINITE ELEMENT METHODS**	**L-T-P-C: 4-0-0-4**

Course Objectives:

1	To able to establish the mathematical models for the complex analysis problems and predict the nature of solution.
2	To able to formulate the element characteristic for linear and nonlinear matrices and vectors.
3	To able to identify the boundary conditions and their incorporation in to the FE equations.
4	To able to solve the problems with simple geometries, with hand calculations involving the fundamental concepts.

Course Outcomes:

CO1	Establish the mathematical models for the complex analysis problems and predict the nature of solution.
CO2	Formulate the element characteristic for linear and nonlinear matrices and vectors.
CO3	Identify the boundary conditions and their incorporation in to the FE equations.
CO4	Solve the problems with simple geometries, with hand calculations involving the fundamental concepts.

Unit	Description	Hours
I	**Introduction**: Introduction to FEM, Basic Steps, Applications in various areas of Engineering, Advantages, Limitations, Need for FEM, Structure of FEM Package. **Basics of theory of elasticity** Equations of equilibrium, stress-strain relations for 2-d and 3-d, Plane stress, strain and axis symmetric cases. Potential energy, Principle of minimum potential energy, Applications to solve simple spring systems. **Raleigh Ritz method**:- Steps, uses, limitations, applications on simple cases on bars and beams to find displacement equations, Galerkin Approach:- Weighted residual method.	12
II	**One Dimensional Finite element analysis:** Finite element modeling, Numbering scheme, coordinate system, shape functions, Element stiffness matrix & load vector, Finite element equations- Elimination approach Applications of boundary conditions using elimination and, penalty methods. Application problems – 1-d bar element. Thermal Expansion problems.	12

III	**Trusses**: Plane trusses, local & global coordinate systems, element stiffness matrix, stress calculations. Thermal Expansion problems FEM for 2-D Problems: Shape functions, stiffness matrix, strain matrix, load vectors for CST Elements and application problems.	**12**
IV	**1-D Steady state heat conduction**: Governing equation, boundary conditions, 1-D element, for heat conduction & Convection, 1-D heat transfer in fin & Problems, Problems on composite walls, Heat generating Plates.	**08**
V	**Fluid Flow:-** Flow through Porous medium, Fluid flow in pipes and around solid bodies in 1D.Shape function, Stiffness matrix. Convergence criteria, Pascal triangle, Patch Test, Lagrangian Shape function.	**08**

Reference Books:

Sl. No	Title	Author	Volume and Year of Edition
1	**Introduction to Finite Elements in Engineering**	Tirupathi R Chandrupatla	Pearson; 4th edition, 20 December 2011
2	**Finite element Method**	S B Halesh	Sapna Book House, Revised and enlarged edition, 2019
3	**Introduction to Finite Element Analysis and Design**	Bhavani V. Sankar	Wiley; 2nd edition (August 20, 2018)

SYLLABUS FOR THE ACADEMIC YEAR – 2024 - 2025		
II Semester: M.Tech (TPE)		
Sub.Code: 24 TPE 24	**Advanced Design of Heat Transfer Equipments**	**L-T-P-C: 3-0-0-3**

Course Objectives:

1	To able to employ LMTD and Effectiveness methods in the design of heat exchangers and analyze the importance of LMTD approach over AMTD approach.
2	To able to examine the performance of double-pipe counter flow (hair-pin) heat exchangers.
3	To able to design and analyze the shell and tube heat exchanger.
4	To understand the fundamental, physical and mathematical aspects of boiling and condensation.

Course Outcomes:

CO1	Employ LMTD and Effectiveness methods in the design of heat exchangers and analyze the importance of LMTD approach over AMTD approach.
CO2	Examine the performance of double-pipe counter flow (hair-pin) heat exchangers.
CO3	Design and analyze the shell and tube heat exchanger.
CO4	Understand the fundamental, physical and mathematical aspects of boiling and condensation.

Unit	Description	Hours
I	**Double Pipe Heat Exchanger:** Film coefficient for fluids in annulus, fouling factors, Calorific temperature, Average fluid temperature, The calculation of double pipe exchanger, Double pipe exchangers in series parallel arrangements Numerical Problems	08
II	**Shell & Tube Heat Exchangers**: Tube layouts for exchangers, Baffle heat exchangers, Calculation of shell and tube heat exchangers, Shell side film coefficients, Shell side Mass Velocity equivalent diameter, The true temperature difference in a 1-2 heat exchanger, Shell side pressure drop Analysis of performance of 1-2 heat exchanger, Exchanger using Water, Optimum Outlet-water temperature, Solution Exchanger, Optimum Outlet water temperature, Solution Exchanger, Steam as Heating Medium, Optmium use of Exhaust and Process steam, 1-2 exchangers without baffles, Heat recovery in 1-2 exchangers. Efficiency of exchanger, Influence of approach	10

	temperature on correction factor., Tube side pressure drop, Flow Arrangements For Increased Heat Recovery: The calculation of 2-4 exchangers Numerical Problems	
III	**Condensation of Single Vapors:** Condensation on surface-Nusselt theory Condensation between horizontal and Vertical condenser, Condensation inside tubes, Partial Condenser and the Balanced Pressure drop, Influence of Impurities, Vertical condenser-sub-Cooler, Horizontal Condenser-Sub cooler, Vertical reflux type condenser, Condensation of Steam, Numerical Problems.	**06**
IV	**Vaporizers, Evaporators and Reboilers**: Vaporizing processes. Forced and Natural circulation Vaporizer, Reboiler arrangement, Classification of Vaporizing exchanger, Relation between Maximum flux and Maximum film coefficient, Forced circulation vaporizing exchangers, Natural Circulation vaporizing exchangers, Recirculation ratios, reboiler heat balance, temperature potentials in distillations, thermal condition of the feed effect upon the reboiler, Reboiler duty for multi-component mixture,	**08**
V	**Cooling towers**:- Diffusion theory, Relation between wet bulb & dew point temperatures, The Lewis number, effective film, Humdification and dehumidification, Classification of cooling towers, Cooling tower internals and the roll of fill, Heat Balance, Heat Transfer by simultaneous diffusion and convection, Analysis of cooling tower requirements, Determination of the number of diffusion units, Correction for the liquid film resistance, Cooling tower process conditions, Humidification coefficients, Calculation of cooling tower performance. Influence of process conditions upon design, Influence of operating variables, dehumidifiers, Heat transfer from gases, Calculation without a simplified Lewis number, sensible Heat transfer	**08**

Reference Books:

Sl. No	Title	Author	Volume and Year of Edition
1	Process heat transfer	Donald Q .Kern	Tata McGraw Hill Publishing Company Ltd
2	Chemical Process Equipment: selection and design	James R. Couper; W. Roy Penney, James R. Fair, Stanley M. Walas	Elsevier Inc., 2nd ed. 2005.
3	Process Heat Transfer	Sarit K.Das.,	Narosa Publishing House Pvt. Ltd.

SYLLABUS FOR THE ACADEMIC YEAR – 2024 - 2025		
II Semester: M.Tech (TPE)		
Sub.Code: 24 TPE LB2	**CAE LABORATORY**	**L-T-P-C: 0-0-3-1.5**

Course Objectives:

	To understand the Stress concentration on the objects
	To understand the boundary Condition for Convection
	To understand the boundary Condition for Radiation
	To understand the Fluid Flow of Parallel/Counter Flow Heat Exchanger

Course Outcomes:

	Understand the Stress concentration on the objects
	Understand the boundary Condition for Convection
	Understand the boundary Condition for Radiation
	Understand the Fluid Flow of Parallel/Counter Flow Heat Exchanger

Expt.	Description
1.	Determination of deflections and stresses in a perfect frame.
2.	Determination of stress concentration factor for a flat plate with a circular cutout at the center
3.	Temperature Distribution in a simple Parallel/Counter Flow Heat Exchanger
4.	Analysis of Water Cooled Wall Temperature with combined Radiation and Convection Heat Transfer
5.	Analysis of Ball in a Box with Body to Body Radiation
6.	Analysis of Parallel/Counter Flow Heat Exchanger with Fluid Flow
7.	Analysis of Cylinder with Convection
8.	Analysis of 2D Cylinder with wake Vortex

PROFESSIONAL ELECTIVE-III

Professional Elective-III		
1	24TPE251	Alternate Fuels for IC Engine
2	24TPE252	Computational Fluid Dynamics
3	24TPE253	Convective heat transfer

SYLLABUS FOR THE ACADEMIC YEAR – 2024 - 2025		
II Semester: M.Tech (TPE)		
Sub.Code: 24TPE251	**ALTERNATIVE FUELS FOR IC ENGINES**	**L-T-P-C: 3-0-0-3**

Course Objectives:

1	To able to Interpret the suitable alternative fuels like CNG and LNG
2	To study the characteristics of alcohols in SI & CI engines.
3	To able to analyze the various gaseous alternative fuels for IC engine applications
4	To study the various properties of bio fuels and their significance in IC engines

Course Outcomes:

CO1	Interpret the suitable alternative fuels like CNG and LNG
CO2	Explain the characteristics of alcohols in SI & CI engines.
CO3	Analyze the various gaseous alternative fuels for IC engine applications
CO4	Determine various properties of bio fuels and their significance in IC engines

Unit	Description	Hours
I	**Fuels**: Introduction, Structure of petroleum, Refining process, Products of refining process, Fuels for spark ignition, Knock rating of SI engine fuels, Octane number requirement, Diesel fuels. **Properties of petroleum products**: Specific gravity, Density, Molecular weight, Vapour pressure, Viscosity, Flash point, Fire point, Cloud point, Pour point, Freezing point, Smoke point & Char value, Aniline point, Octane Number, Performance Number, Cetane Number, Emulsification, Oxidation Stability, Acid Value/Number, Distillation Range, and Sulphur content.	12
II	**Alternative fuels for I.C. engines**: Need for alternative fuels such as Ethanol, Methanol, LPG, CNG, Hydrogen, Biogas and Producer gas and their methods of manufacturing.	04
III	**Single Fuel Engines**: Properties of alternative fuels, Use of alternative fuels in SI engines, Engine modifications required, Performance and emission characteristics of alternative fuels in SI mode of operation v/s gasoline operation. **Dual fuel Engine**: Need and advantages, The working principle, Combustion in dual fuel engines, Factors affecting combustion in dual fuel engine, Use of alcohols, LPG, CNG, Hydrogen, Biogas and Producer gas in CI engines in dual fuel mode. Engine modifications required. Performance and emission characteristics of alternative fuels (mentioned above) in Dual Fuel mode of operation v/s Diesel operation. .	12

IV	**Bio-diesels**: What are bio-diesels Need of bio-diesels, Properties of bio-diesels v/s petro-diesel, Performance and emission characteristics of bio-diesels v/s Petro diesel operation.	06
V	**Availability:** Suitability & Future prospects of these gaseous fuels in Indian context. **Environmental pollution:** with conventional and alternate fuels, Pollution control methods and packages	06

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	**A Course in Internal Combustion Engines**	R.P Sharma & M.L. Mathur,	Danpat Rai & Sons.
2	**Elements of Fuels, Furnaces & Refractories**	O.P. Gupta,	Khanna Publishers
3	**Internal Combustion Engines**	Domkundwar V.M	I Edition, Dhanpat Rai & Sons

SYLLABUS FOR THE ACADEMIC YEAR – 2024 - 2025		
II Semester: M.Tech (TPE)		
Sub. Code: 24TPE252	**COMPUTATIONAL FLUID DYNAMICS**	**L-T-P-C: 3-0-0-3**

Course Objectives:

1	To study the stepwise procedure to completely solve a fluid dynamics problem using computational methods.
2	To study the governing equations and understand the behavior of the equations.
3	To study the consistency, stability and convergence of various discretization schemes for parabolic, elliptic and hyperbolic partial differential equations.
4	To study the verify variations of SIMPLE schemes for incompressible flows and Variations of Flux

Course Outcomes:

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 behavior 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

Unit	Description	Hours
I	**Governing Equations:** Review of equations governing fluid flow and heat transfer. Neumann boundary conditions, partial differential equations, Dirichlet boundary conditions.	06
II	**Finite difference:** Discretization, consistency, stability and fundamentals of fluid flow modeling, application in heat conduction and convection, steady and unsteady flow.	06
III	**Finite volume method: Application to steady state Heat Transfer:** Introduction, regular finite volume, discretization techniques, **Application to transient Heat Transfer, application to Convective Heat Transfer.**	10
IV	**Finite Volume Method: Application to Computation of Fluid Flow** SIMPLE algorithms.	08

V	**Solution of viscous incompressible flow:** Stream function and vorticity formulation. Solution of N S equations for incompressible flow using MAC algorithm, **Compressible flows via Finite Difference Methods.**	10

Reference Books:			
Sl. No	**Title**	**Author**	**Volume and Year of Edition**
1	**Numerical Heat Transfer and Fluid Flow**	S.V. Patankar, Company.	Hemisphere Publishing
2	**Computational Fluid Dynamics**	T.J. Chung, S	Cambridge University Pres
3	**Computational fluid flow and heat transfer**	K. Murlidhar and T. Sounderrajan	Narosa Publishing Co..

SYLLABUS FOR THE ACADEMIC YEAR – 2024 - 2025		
II Semester: M.Tech (TPE)		
Sub.Code: 24TPE253	**CONVECTIVE HEAT TRANSFER**	**L-T-P-C: 3-0-0-3**

Course Objectives:

1	To able to understand the fundamental and advanced principles of forced and natural convection heat transfer processes.
2	To able to Formulate and solve convective heat transfer problems
3	To able to relate the principles of convective heat transfer to estimate the heat dissipation from devices.
4	To able to estimate the energy requirements for operating a flow system with heat transfer.

Course Outcomes:

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.

Unit	Description	Hours
I	**Introduction:** Conservation Principles and Fluid Stresses and Flux Laws	**04**
II	**Boundary Layer:** The Differential Equations Of The Laminar Boundary Layer, The Integral Equations Of The Boundary Layer, The Differential Equations Of The Turbulent Boundary Layer.	**06**
III	**Momentum transfer and Heat transfer-I:** Momentum transfer and Heat transfer for Laminar Flow inside Tubes. Momentum transfer and Heat transfer in Laminar External Boundary layer.	**10**

IV	**Momentum transfer and Heat transfer-II:** Momentum transfer and Heat transfer in Turbulent Boundary Layer, Momentum transfer and Heat transfer for Turbulent Flow inside Tubes.	10
V	**Influence of Temperature:** Dependent Fluid Properties, Free-Convection Boundary Layers. **Convective Mass Transfer**: Basic Definitions and Formulation of a Simplified Theory, Evaluation of The Mass-Transfer Conductance, Examples for application of the Simplified Method.	10

Reference Books:

Sl. No	Title	Author	Volume and Year of Edition
1	**Convective Heat and Mass Transfer**	W.M. Kays	John Wiley, 1996.
2	**Heat Transfer**	J.P. Holman	McGraw-Hill Publications. 2022
3	**Principles of Heat Transfer**	Frank Kreith& M. S. Bohn.,	Thomson Publications, 2001

PROFESSIONAL ELECTIVE-IV

Professional Elective-III		
1	24TPE261	Solar Thermal Technologies and applications
2	24TPE262	Design and Analysis of Thermal Systems
3	24 TPE263	Engine Flow and Combustion

SYLLABUS FOR THE ACADEMIC YEAR – 2024 - 2025		
II Semester: M.Tech (TPE)		
Sub.Code: 24TPE261	**SOLAR THERMAL TECHNOLOGIES AND APPLICATIONS**	**L-T-P-C: 3-0-0-3**

Course Objectives:

1	To able to analyze the energy concepts on solar devices for various thermal properties.
2	To able to analyze the solar thermal devices for various tracking modes.
3	To able to evaluate the performance of various solar thermal technologies.
4	To understand solar thermal applications

Course Outcomes:

CO1	Analyze the energy concepts on solar devices for various thermal properties.
CO2	Analyze the solar thermal devices for various tracking modes.
CO3	Evaluate the performance of various solar thermal technologies.
CO4	Understand solar thermal applications

Unit	Description	Hours
I	**Solar Radiation:** Location on earth, celestial sphere, horizon and equatorial system, Instruments for measuring solar radiation and sunshine, description of the various angles depicting the relation between sun and earth, coordinates transformation, solar time, obliquity and declination of the sun, apparent motion of the sun, sun rise and sun set time, east west time, analysis of the direct daily solar radiation on any arbitrarily located surface.	08
II	**Flat Plate Collectors:** Performance analysis, transmissivity of the cover system, overall loss coefficient and heat transfer correlations, collector efficiency factor, collector heat removal factor, effects of various parameters on the performance. Evacuated Tube Collectors Principle of working, advantages of ETC over FPC, Types of evacuated tubes. Design aspects of solar plate collectors.	08
III	**Concentrating collectors**: types, description of cylindrical parabolic collector, orientation and tracking modes, performance analysis, parametric study of collector performance in different modes of operation, compound parabolic collector geometry, tracking requirements, parabolic dish collector	06
IV	**Thermal Energy Storage:** Introduction, sensible heat storage: liquids, solids, analysis of liquid storage tank in well mixed condition and thermal stratification, analysis of packed-bed storage, latent heat storage, thermo chemical storage.	10

V	**Applications:** Water heating systems (Natural and Forced), Industrial process heating system, Active and passive space heating, Solar absorption refrigeration, Power generation (Low Temperature, Medium Temperature, High Temperature), Distillation, Drying, Cooking, Solar Pond. Recent advancement in materials and systems for thermal energy storage systems.	08

Reference Books:

Sl. No	Title	Author	Volume and Year of Edition
1	**Solar Energy-Principles of Thermal Collection & Storage**	S.P. Sukhatme,	Tata McGraw-Hill
2	**Solar energy Thermal Process**	John A. Duffie &, William A. Bechkam	Wiley-Inter science publication. New York.
3	**Solar Energy - Fundamentals and Application**	H.P. Garg & J. Prakash	Tata McGraw-Hill

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SYLLABUS FOR THE ACADEMIC YEAR – 2024 - 2025		
II Semester: M.Tech (TPE)		
Sub.Code: 24TPE262	**DESIGN & ANALYSIS OF THERMAL SYSTEMS**	**L-T-P-C: 3-0-0-3**

Course Objectives:

1	To understand the physics and the mathematical treatment of typical heat exchangers.
2	To able to employ LMTD and Effectiveness methods in the design of heat exchangers and analyze the importance of LMTD approach over AMTD approach.
3	To able to examine the performance of double-pipe counter flow (hair-pin) heat exchangers.
4	To able to design and analyze the shell and tube heat exchanger.

Course Outcomes:

CO1	Understand the physics and the mathematical treatment of typical heat exchangers.
CO2	Employ LMTD and Effectiveness methods in the design of heat exchangers and analyze the importance of LMTD approach over AMTD approach.
CO3	Examine the performance of double-pipe counter flow (hair-pin) heat exchangers.
CO4	Design and analyze the shell and tube heat exchanger.

Unit	Description	Hours
I	**Introduction to Thermal System Design:** Introduction; Workable, optimal and nearly optimal design; Thermal system design aspects; concept creation and assessment; Computer aided thermal system design. **Thermodynamic modeling and design analysis:** First and second law of thermodynamics as applied to systems and control volumes, Entropy generation; Thermodynamic model – Cogeneration system.	08
II	**Energy Analysis :-** Energy definition, dead state and energy components ; Physical Energy – Energy balance ; Chemical Energy ; Applications of energy analysis; Guidelines for evaluating and improving thermodynamic effectiveness. **Heat transfer modeling and design analysis:-** Objective of heat transfer processes; Review of heat transfer processes involving conduction, convection and radiation and the corresponding heat transfer equations used in the design.	08
III	**Design of piping and pump systems:-** Head loss representation ;Piping networks; Hardy – Cross method ; Generalized Hardy – Cross analysis ; Pump testing methods ; Cavitation considerations ; Dimensional analysis of pumps ; piping system design practice	10

IV	**Thermo-economic analysis and evaluation:-** Fundamentals of thermo-economics, Thermo-economic variables for component evaluation ; thermo-economic evaluation ; additional costing considerations.	06
V	**Thermo-economic optimization:-** Introduction ; optimization of heat exchanger networks ; analytical and numerical optimization techniques ; design optimization for the co-generation system- a case study ; thermo-economic optimization of complex systems.	08

Reference Books:

Sl. No	Title	Author	Volume and Year of Edition
1	**Thermal Design & Optimization**	Bejan, A., et al.,	John Wiley, 1996.
2	**Analysis & Design of Thermal Systems**	Hodge, B.K.,	2nd edition, Prentice Hall, 1990.
3	**Design of Thermal Systems**	Stoecker, W.F.,	McGraw-Hill.

SYLLABUS FOR THE ACADEMIC YEAR – 2024 - 2025		
II Semester: M.Tech (TPE)		
Sub.Code: 24 TPE263	**ENGINE FLOW AND COMBUSTION**	**L-T-P-C: 3-0-0-3**

Course Objectives:

1	To able to understand the concepts of combustion phenomena in energy conversion devices
2	To able to understand the concepts of combustion phenomena in energy conversion devices.
3	To able to Analyze the implementation limits with regard to performance, emission and materials
4	To able to identify and understand possible harmful emissions and the legislation standards

Course Outcomes:

CO1	Understand the concepts of combustion phenomena in energy conversion devices
CO2	Understand the concepts of combustion phenomena in energy conversion devices.
CO3	Analyze the implementation limits with regard to performance, emission and materials compatibility
CO4	Identify and understand possible harmful emissions and the legislation standards

Unit	Description	Hours
I	**Gas exchange process:** Inlet & exhaust processes in four stroke cycle, volumetric efficiency, flow through valves, residual gas fraction, exhaust gas flow rate and temperature variation, super charging, turbo charging.	**06**
II	**Charge motion with in the cylinder:** Intake jet flow, mean velocity turbulence characteristics, swirl, squish, pre chamber engine flows, crevice flow and blow by, flows generated by piston cylinder wall interaction.	**06**
III	**Combustion in SI engines:** Essential features of the process, thermodynamics analysis, burned and unburned mixture states, analysis of cylinder pressure data, combustion processes characterization, flame structure and speed, cyclic variations in combustion, partial burning and misfire, spark ignition and alternative approaches, abnormal combustion, knock and surface ignition. **Combustion in CI engines:** Essential features of the process, types of diesel combustion systems, fuel spray behavior, and ignition delay, mixing controlled combustion.	**08**
IV	**Pollutant formation and control:** Nature of the problem, nitrogen oxide, carbon	**10**

	monoxide, un-burnt hydrocarbon emissions, particulate emissions, exhaust gas treatment.	
V	**Engine heat transfer:** Model of heat transfer, engine energy balance, intake and exhaust heat transfer, radiations from gases, flame radiation component, temperature distributions, effect of engine variables. **Super Charging and Engine Performance.**	10

Reference Books:

Sl. No	Title	Author	Volume and Year of Edition
1	**Internal Combustion Engines**	V. Ganesan,	Tata McGraw-Hill
2	**IC Engines fundamentals**	John B. Heywood,	McGraw-Hill
3	**Internal Combustion Engines: Applied Thermo sciences**	C.R. Fergusan,	John Wiley & Sons.

GUIDELINES FOR PREPARATION OF PROJECT REPORTS

ARRANGEMENT OF CHAPTERS -

1. **Cover title page -**Format enclosed
2. **Inner title page –** Same as cover title page
3. **Certificate** from guide and head with declaration by the student
4. **Certificate** from Company / Firm whether the project work is carried out.

   (Not required if done themselves)
5. **Acknowledge**
6. **List of tables and figures**
7. **Abbreviations** / operational definitions used
8. **Introduction** should include the following:
   a. Problem definition / statement. This will cover company profile to the topic chosen pertain to the company – 5 pages
   b. Research Objectives (maximum 5) – 1 page
   c. Research Methodology – state the basic and secondary research design. If it a simple survey, explain sampling design and questionnaire design, sources of data and techniques of data analysis – 3, 4 pages
   d. Limitations of Project study – 1 page
9. **Chapter – 1: Literature review**

   Discuss the theory, concepts, hypotheses, models, etc., underpinning the project work (Project report is an application of the theoretical knowledge in analyzing a real life problem/issue faced by an organization) – 15 pages
10. **Chapter – II, III & IV**: **Findings**

    This is the longest section of the project report. In this chapter, data collected will be presented and analysed without drawing any inference.

    Depending on the volume of the data presented, there could be 3 to 4 chapters in this section. – at least 40 pages

11. **Chapter V: Summary of Findings**

    This chapter be a brief statement of analysis already stated in the findings section – 3 pages

12. **Chapter VI: Conclusions and suggestions –** 3 pages

    Total number of pages must be at least 80 but not more than 100.

13. **Bibliography:** References like articles, books, websites, etc., used in the project work must be included in this section strictly following the citation style prescribed by the University.

14. **Appendix:** This will include printed secondary data (only if it is very critical) and any questionnaire used for the study.