Faculty of Engineering & Technology
P.K.University
Shivpuri (MP)

Evaluation Scheme & Syllabus for
Department of Mechanical Engg.

M.Tech (Thermal Engg.)
(I Semester)
(Effective from session 2025-26)

EVALUATION SCHEME

M.Tech THERMAL ENGG. (I SEMESTER)

STUDY AND EVALUATION SCHEME FOR M.TECH THERMAL ENGINEERING

SEMESTER-I

SUBJECT CODE	SUBJECTS NAME	STUDY SCHEME Periods/Week			Credits	MARKS IN EVALUATION SCHEME						Total Marks of Internal & External
						INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT			
		L	T	P		Th	Pr	Tot	Th	Pr	Tot	
MSIMUTH101	Simulation ,Modeling, & Analysis	3	1	0	4	30	-	30	70	-	70	100
MADVATH102	Advanced Thermal Engineering	3	1	0	4	30	-	30	70	-	70	100
MALTETH103	Alternative Fuels and Engines Pollution	3	1	0	4	30	-	30	70	-	70	100
MADVATH104	Advanced I.C Engines	3	0	0	3	30	-	30	70	-	70	100
URESETH105	Research Process & Methodology	3	0	0	3	30	-	30	70	-	70	100
MSIMUME106	Simulation ,Modeling, & Analysis Lab	0	0	2	1		25	25	-	25	25	50
MDAVATH107	Advanced Thermal Engineering	0	0	2	1		25	25	-	25	25	50
Total		15	3	4	20	150	50	200	350	50	400	600

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L	T	P
3	1	0

MSIMUTH101
Simulation, Modeling & Analysis

UNIT I Introduction: Simulation: a tool, advantages and disadvantages of simulation, areas of application, systems and system environment, components of a system, discrete and continuous systems, discrete event system simulation. General Principles: Concepts in discrete event simulation, time advance algorithm, manual simulation using event scheduling, basis properties and operations.

UNIT II:Models In Simulation: Terminology and concepts, statistical models: queuing systems; inventory systems; reliability and maintainability, limited data, discrete distributions: Bernoulli distribution; Bionomial distribution; Geometric distribution, continuous distribution: Uniform distribution; Exponential distribution; Gamma distribution; Normal distribution; Weibull distribution; Triangular Distribution; Lognormal distribution, poisson process,

UNIT III:Queueing Models: Characteristics of queuing systems, the calling population, system capacity, arrival process, service mechanism, queuing notations, long run measures of performance of queuing systems, server utilization in G/G/1/∞/∞ queues, server utilization in G/G/C/∞/∞ queues, server utilization and system performance, costs in queuing problems, Larkovian models.

UNIT IV:Random Number Generation: Properties of random numbers, Pseudo random numbers, techniques of generating random numbers, tests of random numbers. Random Variate Generation: Inverse transform technique, Direct transformation for the Normal and Lognormal distribution, Convolution Method, Acceptance rejection technique.

UNIT V:Input Modelling And Validation: Steps in the development of model, data collection, Distribution identification, Parameter estimation, Goodness of Fit Tests,selecting input models without data, verification and validation of simulation models.

Books:

1. Simulation Modelling and Analysis by Law and Kelton, Mc Graw Hill.
2. Simulation Model Design& execution by Fishwich, Prentice Hall.
3. Discrete event system simulation by Banks, Carson, Nelson and Nicol.

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MADVATH102

Advanced Thermal Engineering

UNIT I:

REVIEW OF THERMODYNAMIC LAWS AND COROLLARIES: Transient flow analysis, Second law thermodynamics, Entropy, Availability and unavailability, Thermodynamic potential. Maxwell relations, Specific heat relations, Maxer's relation, Evaluation of thermodynamic properties of working substance.

UNIT II:

FINITE DIFFERENCE METHODS FOR CONDUCTION: ID & 2D steady state and simple transient heat conduction problems-implicit and explicit methods.

Forced Convection: Equations of fluid flow-concepts of continuity, momentum equations- derivation of energy equationmethods to determine heat transfer coefficient: Analytical methods- dimensional analysis and concept of exact solution. Approximate method-integral analysis. **Viscous Flow:** Derivation of Navier-Stoke's Equations for viscous compressible flow – Exact solutions to certain simple cases: Plain Poisoulle flow - Coutte flow with and without pressure gradient - Hagen Poisoulle flow - Blasius solution.

UNIT III:

POWER CYCLES: Review binary vapour cycle, co-generation and combined cycles, Second law analysts of cycles. Refrigeration cycles, Thermodynamics off irreversible processes, Introduction, Phenomenological laws, Onsaga Reciprocity relation, Applicability of the Phenomenological relations, Heat flux and entropy production, Thermodynamic phenomena, Thermo electric circuits.

UNIT IV:

GAS DYNAMICS: Fundamental thermodynamic concepts, isentropic conditions, Mach numbers and area, Velocity relations, Dynamic Pressure, Normal shock relation for perfect gas, Supersonic flow, oblique shock waves, Normal shock recoveries, detached shocks, Aero-foil theory.

REFERENCES:

1. Basic and Applied Thermodynamics/ P.K.Nag/ TMH
2. Element of Gas Dynamics/Yahya/TMH
3. Fluid Mechanics and Machines/Modi and Seth/Standard Book House

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MALTETH103
Alternative Fuels and Engines Pollution

- Alternative fuels, Biodiesel production & specifications, trans-esterification process, alcohol, emulsified fuels, DME, GTI,
- Introduction to gaseous alternative fuels, Hydrogen, production, storage, combustive properties of hydrogen, hydrogen induction systems, Compressed natural gas, production, supply, storage, filling systems, LPG.
- Pollutants due to transportation systems, Nature of pollutants and their formation, Local and global effects of pollutants, Effects of engine pollutants on human health, Photochemical smog, Emission regulations, regulated/unregulated pollutants, technologies to control engine pollution

REFERENCES:

1. Handbook of Alternative Fuel Technologies/Sunggyu Lee /Publisher: Taylor & Francis Inc.

2. Alternative Transportation Fuels: Utilization in Combustion Engines published / K.A. Subramanian /CRC Press.

L	T	P
3	0	0

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MADVATH104
Advanced I.C. Engines

UNIT I :

INTRODUCTION: Historical Review – Engine Types – Design and operating Parameters. Cycle Analysis: Thermo-chemistry of Fuel – Air mixtures, properties – Ideal Models of Engine cycles – Real Engine cycles - differences and Factors responsible for – Computer Modeling.

UNIT II:
GAS EXCHANGE PROCESSES: Volumetric Efficiency – Flow through ports – Supercharging and Turbo charging. Charge Motion: Mean velocity and Turbulent characteristics – Swirl, Squish – Pre-chamber Engine flows.

UNIT III:
ENGINE COMBUSTION IN S.I ENGINES: Combustion and Speed – Cyclic Variations – Ignition –Abnormal combustion Fuel factors, MPFI, SI engine testing.

COMBUSTION IN CI ENGINES: Essential Features – Types off Cycle. Pr. Data – Fuel Spray Behavior – Ignition Delay – Mixing Formation and control, Common rail fuel injection system.

UNIT IV:
POLLUTANT FORMATION AND CONTROL: Nature and extent of problems – Nitrogen Oxides, Carbon monoxide, unburnt Hydrocarbon and particulate – Emissions – Measurement – Exhaust Gas Treatment, Catalytic converter, SCR, Particulate Traps, Lean, NOx, Catalysts.

UNIT V:
ENGINE HEAT TRANSFER: Importance of heat transfer, heat transfer and engine energy balance, Convective heat transfer , radiation heat transfer, Engine operating characteristics. Fuel supply systems for S.I. and C.I engines to use gaseous fuels like LPG, CNG and Hydrogen.

UNIT VI:
MODERN TRENDS IN IC ENGINES: Lean Burning and Adiabatic concepts, Rotary Engines, Modification in I.C engines to suit Bio – fuels, HCCI and GDI concepts.

REFERENCES:

1. I.C. Engines / V.Ganesan/TMH
2. I.C. Engines Fundamentals/Heywood/TMH
3. I.C. Engines/G.K. Pathak & DK Chevan/ Standerd Publications
4. I.C. Engines /RK Rajput/Laxmi Publications

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L	T	P
3	0	0

MRESETH105

Research Process and Methodology

UNIT 1 :

Introduction to Research and Problem Definition-Meaning, Objective and importance of research, Types of research, steps involved in research, defining research problem.

UNIT 2:

Research Design-Research design, Methods of research design, research process and steps involved, Literature Survey

UNIT 3:

Data Collection-Classification of Data, Methods of Data Collection, Sampling, Sampling techniques procedure and methods, Ethical considerations in research

UNIT 4:

Data Analysis and interpretation-Data analysis, Statistical techniques and choosing an appropriate statistical technique, Hypothesis, Hypothesis testing, Data processing software (e.g. SPSS etc.), statistical inference, Interpretation of results

UNIT 5:

Technical Writing and reporting of research-Types of research report: Dissertation and Thesis, research paper, review article, short communication, conference presentation etc., Referencing and referencing styles, Research Journals, Indexing and citation of Journals, Intellectual property, Plagiarism

Text Books:

1. C. R. Kothari, Gaurav Garg, Research Methodology Methods and Techniques , New Age International publishers, Third Edition.
2. Ranjit Kumar, Research Methodology: A Step-by-Step Guide for Beginners, 2nd Edition, SAGE, 2005
3. Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition

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MSIMUTH106
Simulation Modeling and Analysis Lab

LIST OF EXPERIMENTS:-

1. Study of simulation software Like ARENA , MATLAB.
2. Simulation of translational and rotational mechanical systems
3. Simulation of Queuing systems
4. Simulation of Manufacturing System 5. Generation of Random number
6. Modeling and Analysis of Dynamic Systems
7. Simulation mass spring damper system
8. Simulation of hydraulic and pneumatic systems.
9. Simulation of Job shop with material handling and Flexible manufacturing systems.
10. Simulation of Service Operations

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MADVAH107
Advanced Thermal Engineering

LIST OF EXPERIMENTS:-

1. Performance analysis of four strokes S.I. Engine- Determination of indicated and brake thermal efficiency, specific fuel consumption at different loads, Energy Balance.
2. Performance analysis of four strokes C.I. Engine- Determination of indicated and brake thermal efficiency, specific fuel consumption at different loads, Energy Balance.
3. Performance analysis of an alternate fuel on computerized IC Engine test rig.
4. Calculation of thermal conductivity of metal rods.
5. Experiment on Pin fin Apparatus (free and force convection heat transfer).
6. COP calculation on air conditioning test rig apparatus.
7. COP calculation on simple vapour compression refrigeration test rig.
8. Performance test and analysis of exhaust gases of an I.C. Engine.
9. Dryness fraction estimation of steam
10. Compressibility factor measurement of different real gases.