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

Evaluation Scheme & Syllabus for
Department of Mechanical Engg.

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

EVALUATION SCHEME

M.Tech THERMAL ENGG. (II SEMESTER)

STUDY AND EVALUATION SCHEME FOR M.TECH THERMAL ENGINEERING

SEMESTER-II

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	
MADVATH201	Advanced Heat & Mass Transfer	3	1	0	4	30	-	30	70	-	70	100
MCOMPTH202	Computational Fluid Dynamics	3	1	0	4	30	-	30	70	-	70	100
MADVATH203	Alternative Finite Element Analysis	3	1	0	4	30	-	30	70	-	70	100
MCONVTH204	Convective Heat Transfer	3	0	0	3	30	-	30	70	-	70	100
UADVATH205	Advanced Power Plant Engineering	3	0	0	3	30	-	30	70	-	70	100
MSEMITH206	Seminar - I	0	0	2	1		25	25	-	25	25	50
	Total	15	3	4	20	150	50	200	350	50	400	600

L	T	P
3	1	0

Department Of Mechanical engineering
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I Year II Semester

MADVAH201

Advanced Heat & Mass Transfer

BRIEF INTRODUCTION TO DIFFERENT MODES OF HEAT TRANSFER: Conduction:
General heat Conduction equation-initial and boundary conditions. Transient heat conduction: Lumped system analysis-Heisler charts-semi infinite solid-use of shape factors in conduction-2D transient heat conduction-product solutions.

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 equation- methods to determine heat transfer coefficient: Analytical methods-dimensional analysis and concept of exact solution. Approximate method-integral analysis.

EXTERNAL FLOWS: Flow over a flat plate: integral method for laminar heat transfer coefficient for different velocity and temperature profiles. Application of empirical relations to variation geometries for laminar and turbulent flows. Internal flows: Fully developed flow: integral analysis for laminar heat transfer coefficient types of flow-constant wall temperature and constant heat flux boundary condition shydro dynamic & thermal entry lengths; use of empirical correlations.

FREE CONVECTION: Approximate analysis on laminar free convective heat transfer approximation-different geometries-combined free and forced convection. Boiling and condensation: Boiling curve-correlations-Nusselts theory of film condensation on a vertical plate-assumptions & correlations of film condensation for different geometries.

RADIATION HEAT TRANSFER: Radiant heat exchange in grey, non-grey bodies, with transmitting. Reflecting and absorbing media, specular surfaces, and gas radiation-radiation from flames.

REFERENCES: 1. Principals of Heat Transfer/Frank Kreith/Cengage Learning

2. Elements of Heat Transfer/E. Radha Krishna/CRC Press/2012
3. Heat Transfer/RK Rajput/S.Chand
4. Introduction to Heat Transfer/SK Som/PHI
5. Engineering Heat & Mass Transfer/Mahesh Rathore/Lakshmi

Publications.

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MCOMPTH202
Computational Fluid Dynamics

UNIT I:
INTRODUCTION: Finite difference method, finite volume method, finite element method, governing equations and boundary conditions, Derivation of finite difference equations.

UNIT II:
SOLUTION METHODS: Solution methods of elliptical equations — finite difference formulations, interactive solution methods, direct method with Gaussian elimination. Parabolic equations-explicit schemes and Von Neumann stability analysis, implicit schemes, alternating direction implicit schemes, approximate factorization, fractional step methods, direct method with tridiagonal matrix algorithm.

UNIT III:
HYPERBOLIC EQUATIONS: explicit schemes and Von Neumann stability analysis, implicit schemes, multi-step methods, nonlinear problems, second order one-dimensional wave equations. Burgers equations: Explicit and implicit schemes, Runge-Kutta method.

UNIT IV:
FORMULATIONS OF INCOMPRESSIBLE VISCOUS FLOWS: Formulations of incompressible viscous flows by finite difference methods, pressure correction methods, vortex methods. Treatment of compressible flows: potential equation, Euler equations, Navier-stokes system of equations, flow field-dependent variation methods, boundary conditions, example problems.

UNIT V:
FINITE VOLUME METHOD: Finite volume method via finite difference method, formulations for two and three-dimensional problems.

STANDARD VARIATIONAL METHODS: Linear fluid flow problems, steady state problems, Transient problems.

REFERENCES:

1. Computational fluid dynamics/ T. J.C'hung/ Cambridge University press,2002.
2. Text book of fluid dynamics/ Frank Choriton/ CBS Publishers & distributors, 1985
3. Numerical heat transfer and fluid flow / Suhas V. Patankar/ Hema shava Publishers corporation & Mc Graw Hill.

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MADVATH203
Advanced Finite Element Analysis

INTRODUCTION TO FEM: basic concepts, historical back ground, applications of FEM, general description, comparison of FEM with other methods, variational approach, Glerkin's Methods. Co-ordinates, basic element shapes, interpolation function, Virtual energy principle, Rayleigh – Ritz method, properties of stiffness matrix, treatment of boundary conditions, solution of system of equations, shape functions and characteristics, Basic equations of elasticity, straindisplacement relations.

1 -D STRUCTURAL PROBLEMS: Axial bar element – stiffness matrix, load vector, temperature effects, Quadratic shape functions and problems.

ANALYSIS OF TRUSSES : Plane Trusses and Space Truss elements and problems

ANALYSIS OF BEAMS : Hermite shape functions – stiffness matrix – Load vector – Problems. 2-D PROBLEMS: CST, LST, force terms, Stiffness matrix and load vectors, boundary conditions, Isoparametric elements – quadrilateral element, shape functions – Numerical Integration. Finite element modeling of Axi-symmetric solids subjected to Axi-symmetric loading with triangular elements.

3-D PROBLEMS: Tetrahedran element – Jacobian matrix – Stiffness matrix.

SCALAR FIELD PROBLEMS: 1 -D Heat conduction-Slabs – fins - 2-D heat conduction problems –Introduction to Torsional problems.

Dynamic considerations, Dynamic equations – consistent mass matrix – Eigen Values, Eigen vector, natural frequencies – mode shapes – modal analysis.

REFERENCES:

1. The Finite Element Methods in Engineering / SS Rao / Pergamon.

2. Finite Element Methods: Basic Concepts and applications, Alavala, PHI

3. Introduction to Finite Elements in Engineering, Chandrupatla, Ashok and Belegundu, Prentice –Hall

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MCONVTH204

Convective Heat Transfer

INTRODUCTION TO FORCED, FREE & COMBINED CONVECTION :– convective heat
transfer coefficient – Application of dimensional analysis to convection – Physical interpretation of dimensionless numbers. Equations of Convective Heat Transfer: Continuity, Navier-Strokes equation & energy equation for steady state flows – similarity – Equations for turbulent convective heat transfer – Boundary layer equations for laminar, turbulent flows – Boundary layer integral equations.

EXTERNAL LAMINAR FORCED CONVECTION: Similarity solution for flow over an isothermal plate – integral equation solutions – Numerical solutions – Viscous dissipation effects on flow over a flat plate. External Turbulent Flows: Analogy solutions for boundary layer flows – Integral equation solutions – Effects of dissipation on flow over a flat plate. Internal Laminar Flows: Fully developed laminar flow in pipe, plane duct & ducts with other cross-sectional shapes

Internal Turbulent Flows: Analogy solutions for fully developed pipe flow – Thermally developing pipe & plane duct flow.

NATURAL CONVECTION: Boussineq approximation – Governing equations – Similarity – Boundary layer equations for free convective laminar flows – Numerical solution of boundary layer equations. Free Convective flows through a vertical channel across a rectangular enclosure – Horizontal enclosure – Turbulent natural convection.

COMBINED CONVECTION: Governing parameters & equations – laminar boundary layer flow over an isothermal vertical plate – combined convection over a horizontal plate – correlations for mixed convection – effect of boundary forces on turbulent flows – internal flows
- internal mixed convective flows – Fully developed mixed convective flow in a vertical plane channel & in a horizontal duct.

CONVECTIVE HEAT TRANSFER THROUGH POROUS MEDIA: Area weighted velocity – Darcy flow model – energy equation – boundary layer solutions for 2-D forced convection – Fully developed duct flow – Natural convection in porous media – filled enclosures – stability of horizontal porous layers.

REFERENCES: 1. Introduction to Convective Heat Transfer Analysis/ Patrick H. Oosthuigen & David Naylor/McGraw Hill
2. Convective Heat & Mass Transfer /Kays & Crawford/TMH

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MADVATH205

Advanced Power Plant Engineering

UNIT I:

INTRODUCTION TO POWER PLANTS AND BOILERS; Layout of Steam, Hydraulic, Diesel, MHD, Nuclear and Gas turbine Power Plants Combined Power cycles – comparison and selection, Load duration Curves Steam boilers and cycles – High pressure and Super Critical Boilers – Fluidized Bed Boilers.

UNIT II:

STEAM POWER PLANT: Fuel and ash handling ,Combustion Equipment for burning coal, Mechanical Stokers. Pulveriser, Electrostatic Precipitator, Draught- Different Types, Surface condenser types, cooling Towers.

UNIT III:

NUCLEAR AND HYDEL POWER PLANTS : Nuclear Energy-Fission , Fusion Reaction, Types of Reactors, Pressurized water reactor ,Boiling water reactor, Waste disposal and safety Hydel Power plant- Essential elements, Selection of turbines, governing of Turbines- Micro hydel developments.

UNIT IV:

DIESEL AND GAS TURBINE POWER PLANT: Types of diesel plants, components , Selection of Engine type, applications-Gas turbine power plant- Fuels- Gas turbine material – open and closed cycles- reheating – Regeneration and intercooling – combines cycle.

UNIT V:

OTHER POWER PLANTS AND ECONOMICS OF POWER PLANTS; Geo thermal
OTEC- tidal- Pumped storage –Solar central receiver system Cost of electric Energy- Fixed and operating costs-Energy rates- Types tariffs- Economics of load sharing, comparison of various power plants.

TEXT BOOKS:

1. Arora S.C and Domkundwar S, ―A Course in Power Plant Engineering‖, Dhanpat Rai, 2001.
2. Nag P.K ,‖Power Plant Engineering‖. Third edition Tata McGraw- Hill , 2007.