

**SYLLABUS PRESCRIBED FOR
TWO YEAR P. G. DEGREE COURSE IN M.E. (F.T.)
THERMAL ENGINEERING (C.G.S.)
FIRST SEMESTER**

1MTE1 ADVANCED MATHEMATICS

SECTION – A

Partial Differential Equations: Linear partial differential equations with constant coefficients and its solution, complimentary function and particular integral. Applications of Partial Differential Equations: Method of separation of variables, solution of wave equation, one dimensional and two dimensional heat flow equation in steady state (Laplace Equation) and its solution.

SECTION – B

Statistics:-Method of least squares, curve fitting by graphical method.Co-relation regression, probability, axioms of probability, Baye's theorem, conditional probability, probability distribution; Binomial, Poisson's and Normal Distribution Interpolation:-Newton's interpolation formulae, Newton's and Gauss's forward and backward interpolation formulae, Interpolation with unequal intervals, Lagrange's formula for unequal intervals. Newton's divided difference formula. Inverse interpolation Numerical Methods: Numerical integration, Newton-Cote's formula, Trapezoidal rule, Simpson's one third and three eighth rule, Waddle's rule. Numerical solution of ordinary differential equations; Taylor's series, Runge-Kutta's fourth order method, Euler's method, Milne's predictor-corrector method

TEXT BOOKS :

1. Advance Engineering Mathematics by Erwin Kreyszig, 7th and 8th Edition. Wiley Eastern.
2. Higher Engineering Mathematics by B. S. Grewal,

REFERENCE BOOKS :

1. Fundamentals of Statistics by S. C. Gupta.

1MTE2 ADVANCED THERMODYNAMICS

SECTION –A

Introduction And Overview: Introductory Concepts and Preliminaries; Properties of Pure Substances; Energy and the First Law of Thermodynamics, Energy Transfer by Heat, Work, and Mass; Second Law of thermodynamics, Entropy: A Measure of Disorder, Exergy – A Measure of Work Potential. The Two Laws Combined: Review on some consequences of first Law, Limitations of first Law, Thermodynamic Temperature Scale, Clausius- Clapeyron Equation, Stefan' s Law, Helmholtz and Gibbs Functions, Availability in Steady Flow, Irreversibility and Effectiveness, Combined First and Second Laws, Isothermal and Adiabatic Compressibility; Joule- Kelvin Coefficient, Maxwell Equation, Vander Wall's Gas Equation; The Destruction Of Energy: Lost Available Work, Mechanisms of Entropy Generation or Energy Destruction, Entropy Generation Minimization.

SECTION -B

Multi Phase Systems: General considerations, Dalton & Amagat Model, Mixture of gases and vapors. Changes in Molal Properties upon Mixing, Gibbs Entropy Equation and Gibbs -

Duhem Equation Chemically Reactive Systems : Thermodynamics of reactive Systems and Criterion of Equilibrium, Phase rule. Combustion Process, Enthalpy of formation; First Law Analysis of Reacting Systems; Second Law analysis of Reacting Systems, Equilibrium Constant and its temperature Dependence. Thermodynamic Optimization : Energy analysis of Vapor and Gas Power Cycles, Guideline for improving Thermodynamic Effectiveness; Energy analysis of Simple Power Plant (Steam Plant)

TEXT BOOKS:

1. Advanced Engineering Thermodynamics, Adrian Bejan, Wiley-Interscience Publication, Second Edition, ISBN 0-471-14880-6.
2. Fundamentals of Engineering Thermodynamics, Michael Moran & Howard Shapiro, Wiley & Sons, Sixth Edition, ISBN 978-0-471-78735
3. Fundamental of thermodynamics, Richard E. Sonntag, Gordon J.V an W ylen, Claus Borgnakke, John Wiley & Sons publication.

REFERENCE BOOKS:

1. Fundamentals of Classical Thermodynamics, Richard Sonntag, Claus Borgnakke, John Wiley & Sons, Seventh Edition, ISBN: 978-0-470-04192-5.
2. Thermodynamics: An Engineering Approach, Yunus A. Cengel & Michael A. Boles, Sixth Edition, ISBN-13 9780073305370.

1MTE3 FLUID DYNAMICS

SECTION - A

Fluid flow concepts : Euler's equations of motion, Navier stoke equation, equation of continuity, Rotational irrotational flows, potential and stream functions, and flow nets circulations. Vorticity. Basic Function: Uniform stream, sink, vortex, doublet, superposition of functions, flow over half bodies, Rankine bodies, circular cylinder, Magnus effect. Conformal Mapping: Simple transformation and inverse transformations.

SECTION - B

Boundary layer theory: Boundary layer theory for laminar and Turbulent flow, Blasius solution for flat plate, approximate methods, boundary layer separation and control, Effect of roughness. Turbulent flow , Semi empirical theories of turbulence, eddy viscosity, Prandtl's mixing length theory, Karman's Similarity hypothesis, Taylor's Vorticity transfer theory. Compressible Flow: Review of one dimensional compressible flow, approximation to two and three dimensional such as sonic, supersonic flows, small perturbation theory, Shock Waves, Prandtl Mayor's Equation.

TEXT BOOKS :

1. Foundations of Fluid Mechanics, Yuan, S.W., Prentice Hall,
2. Cengel, Y.A. and J.M. Cimbala, Fluid Mechanics, McGraw-Hill, Boston, MA
3. Mechanics of Fluids, Shames, McGraw-Hill.

REFERENCE BOOKS:

1. Boundary Layer Theory, Schlichting, H., McGraw-Hill,.
2. Fluid Mechanics , Kundu, P. K., and Ira M. Cohen, 4th ed., Academic Press
3. The Dynamics and Thermodynamics of Compressible Flow, Shappiro, Ronald Press.

1MTE4 ADVANCED HEAT TRANSFER

SECTION – A

Steady state conduction: Basic fundamentals, One dimensional steady state conduction: critical radius of insulation, Cylinder with heat sources, Fins of non-uniform cross section. Multi dimensional steady state conduction: Two dimensional heat conduction analytical, graphical analysis, Conduction shape factor, Numerical analysis, formulation in terms of resistances of elements, Accuracy considerations Unsteady state heat conduction: Applicability of Heisler charts, Semi-infinite slab and cylinder suddenly exposed to convection, Transient numerical methods. Thermal resistance and capacity formulation. Convection heat transfer: Energy equation of the boundary layer, thermal boundary layer, turbulent boundary layer heat transfer and thickness, Empirical relations for flow across cylinders and tube banks, Liquid metal heat transfer. Natural convection systems, heat transfer on a vertical plate, free convection from horizontal cylinders and inclined surfaces, combined free and forced convection, criteria for free or forced convection.

SECTION - B

Radiation: Introduction to basic fundamentals, Radiation shape factor Heat exchange between non-black bodies using network approach, gas radiation, radiation network for an absorbing and transmitting medium, Effect of radiation on temperature measurement, Radiation heat transfer coefficient. Condensation, Boiling and Heat pipe: heat transfer coefficient during condensation on tube bank Simplified relations for boiling heat transfer with water, transpiration cooling, and ablation; classification, construction and applications of heat pipe. Note : Heat transfer data book will be permitted in Exam hall

TEXT BOOKS :

1. Heat Transfer by J.P. Holman, Tata McGraw Hill Publication, 9 th ed. 2002.
2. Heat Transfer by S.P. Sukhatme, Tata McGraw Hill Publication, 1994.

REFERENCE BOOKS :

1. Heat Transfer by P.K. Nag, Tata McGraw Hill Publication, 2005.
2. Heat and Mass Transfer Data Book Book by C P Kothandaraman, S Subramanyam, New Age International,1994
3. Heat Transfer data book Convective heat & mass transfer by Kays and Crawford, Tata

ELECTIVE - I

1MTE5 1. WASTE MANAGEMENT AND ENERGY GENERATION SYSTEMS

SECTION – A

SOLID WASTE : Definitions - Sources, Types, Compositions, Properties of Solid Waste - Municipal Solid Waste - Physical, Chemical and Biological Property - Collection - Transfer Stations – Waste Minimization and Recycling of Municipal Waste

WASTE TREATMENT :Size Reduction - Aerobic Composting - Incineration - Furnace Type & Design, Medical / Pharmaceutical Waste Incineration – Environmental Impacts - Measures of Mitigate Environmental Effects due to Incineration

WASTE DISPOSAL :Land Fill Method of Solid Waste Disposal - Land Fill Classification, Types, Methods & Siting Consideration - Layout & Preliminary Design of Land Fills - Composition, Characteristics, generation, Movement and Control of Landfill Leachate & Gases - Environmental Monitoring System for Land Fill Gases

SECTION - B

HAZARDOUS WASTE MANAGEMENT

Definition & Identification of Hazardous Waste - Sources and Nature of Hazardous Waste - Impact on Environment - Hazardous Waste Control -Minimization and Recycling - Assessment of Hazardous Waste Sites -Disposal of Hazardous Waste, Underground Storage Tanks Construction, Installation & Closure

ENERGY GENERATION FROM WASTE

Types - Biochemical Conversion - Sources of Energy Generation – Industrial Waste, Agro Residues - Anaerobic Digestion - Biogas Production – Types of Biogas Plant Thermochemical Conversion - Sources of Energy Generation - Gasification - Types of Gasifiers - Briquetting - Industrial Applications of Gasifiers - Utilization and Advantages of Briquetting - Environment Benefits of Biochemical and Thermochemical Conversion

TEXT BOOKS :

1. Parker, Colin, & Roberts, Energy from Waste - An Evaluation of Conversion Technologies, Elsevier Applied Science, London, 1985
2. Shah, Kanti L., Basics of Solid & Hazardous Waste Management Technology, Printice Hall, 2000

REFERENCE BOOKS :

1. Manoj Datta, Waste Disposal in Engineered Landfills, Narosa Publishing House, 1997
2. Rich, Gerald et.al., Hazardous Waste Management Technology, Podvan Publishers, 1987
3. Bhide AD., Sundaresan BB, Solid Waste Management in Developing Countries, INSDOC New Delhi, 1983.

Websites:1. <http://www.bical.net> ,

2. <http://www.volund.dk>,3. <http://www.iswa.org>,4.www.wmrc.uiuc.edu

ELECTIVE - I

1MTE5 2. ENERGY CONSERVATION AND POWER PLANT ECONOMICS

SECTION-A

Energy Conservation : Energy Sources – Review of Present Status of Conventional and Renewable Energy Sources Common areas of inefficiency in energy use, principles of energy conservation , energy conservation planning, energy conservation in industries, household, commercial, transport and agricultural fields, energy conservation technologies, energy conservation legislation. Energy Audit: Energy flow diagram, comparison with standards, energy management team, energy audit of illumination systems and electrical systems, energy audit of various compressed air systems, buildings, steam generation and distribution systems. Demand Side Management: Scope of Demand Side Management, load management as a Demand Side Management strategy, tariff options of Demand Side Management, Demand Side Management and environment, different types as a captive power plants, energy banking and wheeling, role of private sector in energy management.

SECTION-B

Power Plant Economics:Economic analysis of power plants and targets, Load curves, load duration curve, different terms and definitions; Effect of fluctuating load on operation and design of the plant, methods of meeting fluctuating load, cost of electrical energy; operating costs, generation costs, depreciation cost. Cost benefit analysis, Selection of type of

generation; Performance and operating characteristics of power plants; Selection of the generating equipments, Combined operation of power plants; load division between stations, effect of load factor on energy cost, different types of tariffs. Environmental Aspects of Energy Generation : Well-to-Wheel Emission analysis of Energy Sources ,Social and economical issues of the power plants, Greenhouse effect, Acid precipitation- acid rain and acid snow, dry deposition and acid fog. Thermal pollution, air pollution, Radiation from nuclear power plant effluents, clean coal technologies, hydro power plants , environmental clearances.

TEXT BOOKS :

1. Power Station Engineering and Economics B G A Skrotzki , W A Vopat : Tata McGraw Hill Publishing Company Limited, New Delhi,1972.
2. Power Plant Engineering, P K Nag, Tata McGraw Hill Publishing Company Limited, New Delhi ,2006.

REFERENCE BOOKS :

1. Electrical Power Distribution , A S Pabla Tata McGraw Hill Publishing Company Limited, New Delhi ,2004.
2. Generation of Electrical Energy B R Gupta, Eurasia Publishing House Private Limited, New Delhi, 2007.
3. Patterns of Energy Use in Developing Countries, Ashok V Desai, Wiley Eastern limited, Tokyo, 1991

ELECTIVE - I
1MTE5 3. MODERN ENERGY SOURCES

SECTION - A

Solar Energy: Flat plate and concentrating collectors- design, analysis and performance, applications. Thermal Power, Photovoltaic power; Economic Analysis Tidal and Ocean Energy: Applications, Design aspects, Power generation methods, various cycles and analysis.

SECTION - B

Wind Energy: Atmospheric circulation, classification, factors influencing wind, wind shear, turbulence, wind speed monitoring, Betz limit, WECS: classification, characteristics, application, design aspects Geothermal Energy And Magneto Hydrodynamics: Study of various components, Performance and methods of energy conversion. Nuclear Energy: Fusion and fission, study of various components, Design aspects, performance and methods of power generation.

TEXT BOOKS :

1. Power Plant Technology by El- Wakil, McGraw Hill publication.
2. Solar Energy : Fundamentals and Applications (1st Revised Edition),Tata McGraw-Hill,

REFERENCES :

1. Solar Energy: Principles of thermal collection and Storage by Suhas P. Sukhatme ,Second Edition, Tata McGraw-Hill, 2006
2. Principles of Solar Thermal Engineering by F.Kreith & J .F.Kreider, McGraw Hill Publications 1978.
3. Solar Engineering of thermal Processes by J .A.Duffie and W.A.Beckman, John Wiley & Sons publication 1999.

4. Applied Solar Energy by A.B.Meinal & F.P.Meinal, Addison Wesley 1976 publication.

ELECTIVE - I
1MTE5 4. ENVIRONMENT POLLUTION CONTROL

SECTION - A

AIR POLLUTION : Sources and Effect - Acid Rain - Air Sampling and Measurement - Analysis of Air Pollutants - Air Pollution Control Methods and Equipments - Issues in Air Pollution control.

SOLID WASTE MANAGEMENT: Sources and Classification - Characteristics of solid waste-Potential methods of solid waste Disposal – Process and Equipments for Energy Recovery from Municipal Solid Waste and Industrial Solid Waste.

WATER POLLUTION: Sources and Classification of Water Pollutants - Characteristics – Waste Water Sampling Analysis - Waste Water, Treatment – Monitoring compliance with Standards - Treatment, Utilization and Disposal of Sludge.

SECTION - B

OTHER TYPES OF POLLUTION Noise Pollution and its impact - Oil Pollution - Pesticides – Radioactivity Pollution Prevention and Control

POLLUTION FROM THERMAL POWER PLANTS AND CONTROL METHODS: Instrumentation for pollution control - Water Pollution from Tanneries and other Industries and their control

TEXT BOOKS :

1. G.Masters (1991): Introduction to Environmental Engineering and Science, Prentice -Hall International Editions.
- 2.. H.S.Peavy, D.R..Rowe, G.Tchobanoglous (1985):Environmental Engineering - McGraw-Hill Book Company,NewYork.

REFERENCE BOOKS :

1. Environmental Considerations in Energy Development, Asian Development Bank (ADB), Manilla(1991)
2. H.Ludwig, W.Evans (1991): Manual of Environmental Technology in Developing Countries, W.Y.
3. Brockelman and B.N.Lohani, International Book Company, Absecon Highlands, N.J.

SECOND SEMESTER
2MTE1 ADVANCED INTERNAL COMBUSTION ENGINES

SECTION - A

SPARK IGNITION ENGINES:Spark ignition engine mixture requirements – Fuel – Injection systems –Monopoint, Multipoint injection, Direct injection – Stages of combustion – Normal and abnormal combustion – Factors affecting knock –Combustion chambers.

COMPRESSION IGNITION ENGINES:States of combustion in C.I. Engine – Direct and indirect injection systems – Combustion chambers – Fuel spray behaviour – Spray structure, Spray penetration and evaporation – Air motion – Introduction to Turbo charging.

SECTION - B

POLLUTANT FORMATION AND CONTROL: Pollutant – Sources – Formation of carbon monoxide, Unburnt hydrocarbon, NO_x, Smoke and Particulate matter – Methods of controlling Emissions – Catalytic converters and Particulate Traps – Methods of measurements and Introduction to emission norms and Driving cycles.

ALTERNATIVE FUELS: Alcohol, Hydrogen, Natural Gas and Liquefied Petroleum Gas- Properties, Suitability, Merits and Demerits as fuels, Engine Modifications.

RECENT TRENDS: Lean Burn Engines – Stratified charge Engines – homogeneous charge compression ignition engines – Plasma Ignition – Measurement techniques – Laser Doppler, Anemometry.

TEXT BOOK :

1. K.K. Ramalingam, Internal Combustion Engine Fundamentals, Scitech Publications, 2002.
2. R.B. Mathur and R.P. Sharma, Internal combustion Engines.
3. V. Ganesan, Internal Combustion Engines, II Edition, Tata McGraw-Hill, 2002.

REFERENCE BOOKS :

1. Duffy Smith, Auto fuel Systems, The Good Heart Willox Company, Inc.
2. John B. Heywood, Internal Combustion Engine Fundamentals first edition
3. Willard W. Pulkrabek, engineering fundamentals of the Internal Combustion Engine second edition

2MTE2 ADVANCED REFRIGERATION ENGINEERING

SECTION – A

Review of Basic Refrigeration Cycles: Reverse Carnot Cycle, Second Law of Thermodynamics. Vapor Compression Refrigeration. Standard and Actual Compression Cycle. Multi Pressure Systems: Refrigeration Component Matching and System Integration, Thermodynamics of Vapor Absorption Refrigeration, Non Conventional Refrigeration Systems with elementary analysis.

SECTION -B

Properties of Refrigerants: Green House Effect, Numbering and Color Coding of Refrigerants, Recent Trends in Refrigerants. Air as refrigerant and air refrigeration cycles, Refrigerant Component Matching and Designing Refrigeration Components like Compressor, Condenser, Capillary, Condenser, Etc.

TEXT BOOKS :

1. Refrigeration and air conditioning, Ahmadul Ameen, Prentice Hall of India, New Delhi, 2006
2. Refrigeration and air conditioning, C P Arora, Tata McGraw-Hill, 2nd ed ,2003

REFERENCE BOOKS :

1. Refrigeration and Air Conditioning Technology, Tomczyk, J. A., Whitman, W. C., Johnson, W. M., Pub: Delmar S. Africa, 4th edition, 2000.
2. Electricity For Refrigeration, Heating, and Air Conditioning, Russell E. Smith, Delmar Cengage Learning; 7th edition, 2006
3. The ASHRAE Handbooks with CDs, 2005-2008

2MTE3 RESEARCH METHODOLOGY

SECTION – A

Research Concept: Concept, meaning, objectives, motivation; Types of research, approaches (descriptive research, conceptual, theoretical, applied and experimental research) Formulation of Research Task: Literature Review: importance & methods, sources, field study, laboratory experiments, critical analysis of already generated facts, hypothetical proposal for future development and testing, selection of research task, prioritization of research, introduction to hypothesis testing. Mathematical Modeling and Simulation: Concept of modeling, classification of mathematical models, modeling with ordinary differential equations, differential equations, partial differential equations, graphs. Simulation concept, types (quantitative, experimental, computer, statistical), process of formulation of model based on simulation. Experimental Modeling: Definition of experimental design, examples, single factor experiments, guidelines for designing experiments.

SECTION - B

General model of process: Input factors/variables, Output parameters/variables, controllable/uncontrollable variables, dependent/independent variables, compounding variables, extraneous variables and experimental validity. Process optimization and designed experiments: methods for study of response surface, First order design. Determining optimum combination of factors, determination of steepest ascent, Taguchi approach to parameter design. Analysis of Results (Parametric and Non parametric, Descriptive and Inferential Data): types of data, Methods and techniques of data collection, sampling and sample design, Non parametric test, error analysis, analysis of variance, significance of variance, analysis of co-variance, multiple regression, Introduction to Analytical hierarchical process, Factor analysis, Cluster analysis, Fuzzy logic, testing linearity/ non linearity of model, testing adequacy of model. Report Writing : types of report, layout of research report, interpretation of results, layout and format, style of writing, typing, references, pagination, tables, figures, conclusions, appendices.

Landscape of Creativity : Convergent Vs. divergent thinking, creativity, creativity Vs intelligence, creativity abilities, determination of Creativity, increasing creativity, creative achievement, techniques of creativity, collective creativity.

TEXT BOOKS :

1. Research in Education, John W Besr & James V Kahn, Prentice Hall of India, New Delhi.
2. Theories of Engineering Experiments, Schank Fr, Tata McGraw Hill Publishing Ltd., New Delhi.
3. Experimental design by Cochran & Cocks, John Wilely & sons, New Delhi, 2005.

REFERENCE BOOKS :

1. Research Methodology, C R Kothari, Wiley Eastern publishers, New Delhi, 10th edition, 2006.
2. Design of Experiments, Douglas Montgomery, 1995.
3. Formulation of Hypothesis, Willkinson K, P L Bhandarkar, Himalaya Publishing House, Mumbai, 2005.

ELECTIVE – II
2MTE4 (1) HEAT EXCHANGER DESIGN

SECTION-A

Constructional Details And Heat Transfer Types - Shell and Tube Heat Exchangers - Regenerators and Recuperators - Industrial Applications Temperature Distribution and its Implications - LMTD – Effectiveness. Flow Distribution And Stress Analysis Effect of Turbulence - Friction Factor - Pressure Loss – Channel Divergence Stresses in Tubes - Heater sheets and Pressure Vessels - Thermal Stresses - Shear Stresses - Types of Failures.

SECTION-B

Design Aspects Heat Transfer and Pressure Loss - Flow Configuration - Effect of Baffles - Effect of Deviations from Ideality - Design of Typical Liquid - Gas- Gas-Liquid Heat Exchangers Condensers And Evaporators Design Design of Surface and Evaporative Condensers - Design of Shell and Tube - Plate Type Evaporators Cooling Towers Packings - Spray Design - Selection of Pumps - Fans and Pipes – Testing and Maintenance – Experimental Methods.

TEXT BOOKS :

1. Fundamentals of Heat Exchanger Design by Ramesh K. Shah, Dusan P Sekulic, 1st edition, Wiley, 2002.
2. Process Heat Transfer by D.Q. Kern, Tata McGraw Hill Publication, 1999.
3. Mechanical design of hear exchanger design & Pressure vessel component, by Sing K.P. A. I.; Arcturus Publishers Cherry Hill, 2006.

REFERENCE BOOKS :

1. Heat Exchanger Design by Frass & Ozisik, John Wiley and Sons, Newyork, 1997.
2. Convective Heat transfer by Kays and London, Tata McGraw Hill Publication, 1997.
3. ANSI Standards for pipe and nozzle selection, 1996.
4. ASME Section VIII Division for pressure Vessel and Boiler Design Code, 1995.
5. ASME section II, Material Specifications, 1995.

ELECTIVE – II
2MTE4 (2) ADVANCED AIR CONDITIONING SYSTEMS

SECTION - A

Properties of Air Water Mixture, Psychometric Air Conditioning Processes, Dehumidification Processes, Com-fort Air Conditioning, Parameters Affects Comfort Conditions, Cooling Load Calculations, Design Of Air Delivery Sys-tem To Hospital, Auditorium, Hotels Etc., Noise And Vibration Control In Air Conditioning Hall.

SECTION - B

Air Conditioning Component Selection (Component Matching), Designing Air Ducts, Window Air Conditioner / Split Air Conditioner Performance Testing, Energy calculations-Degree-Day procedure, Bin Method, Comprehensive Simulation methods method, Flow-Pump – and piping Design. Electrical Circuits And Components In Air Conditioner Like Olp, Capacitor, Performance Study Of Motors Used For Fan, Blower, Compressor,

TEXT BOOKS :

- 1.Refrigeration and air conditioning, Ahmadul Ameen, Prentice Hall of India, New Delhi, 2006
- 2.Refrigeration and air conditioning, C P Arora, Tata McGraw-Hill,2nd ed, 2003

3. Air Conditioning Principles and Systems, E G Pita, Prentice Hall of India, 4th edition, 2005.

REFERENCE BOOKS :

1. The ASHRAE Handbooks with CDs, 2005-2008
2. Refrigeration and Air Conditioning Technology, Tomczyk, J. A., Whitman, W. C., Johnson, W. M., Pub: Delmar S. Africa, 4th edition, 2000.

ELECTIVE -II
2MTE4 (3) FINITE ELEMENT METHODS

SECTION - A

Introduction Overview of numerical methods - Discretised representation of physical systems - thermal resistance, flow resistance networks, thermal capacitance - Governing equations and Boundary conditions for thermal and flow systems. One Dimensional Heat Conduction Principles of variations calculus - applications of vibrational approach to one dimensional heat conduction -element matrix contribution and assembly. Heat Functions And Analysis Weighted residual methods - Galerkin's approach - Shape functions and interpolations - Application of Galerkin's weighted residual approach to one dimensional heat conduction - Three noded triangular elements, 2D steady state, state conduction using triangular elements – Radiation and natural convective boundary conditions - incorporation of variations in thermal properties.

SECTION - B

Convective Heat Transfer Higher order elements and numerical integration solution of heat conduction and creeping flow using higher order element - Solution of convective heat transfer. Heat Exchanger Applications Incompressible laminar flow simulation - Stream function/Vorticity methods, Velocity Pressure formulation, mixed order interpolation for incompressible flow, modifications for turbulent flow. Application to heat exchanger. Software Codes Description of programs for heat conduction, fluid flow, Assignment problems using these codes.

TEXT BOOKS :

1. The Finite Element Method in Engg., 2nd ed. S.S.Rao Pergamon Press, 1990
2. Applied Finite Element Analysis, 2nd ed, Larry Segerlind John Wiley & Sons, 1988.
3. Finite Element Analysis Theory and Programming 2nd ed, C.S.Krishnamoorthy, Tata mcgraw-Hill 1991.
4. Finite Elements Methods, J.N.Reddy, mcgraw-Hill 1988.
5. Finite Element Methods O.C.Zienkiewicz, mcgraw-Hill 1980
6. Introduction to Finite Elements in Engg., T.R.Chandrapatla and Belegundu, Prentice Hall of India.
7. Finite Element Computational Fluid Mechanics - A.J.Baker, mcgraw-Hill.

ELECTIVE -II
2MTE4 (4) GAS TURBINES & JET PROPULSION

SECTION - A

General Concepts related to Turbo machinery : Classification; Euler's Equation for Turbo machinery; Velocity triangle; Cascade analysis & nomenclature. Shaft Power & Aircraft Propulsion Cycles.

Centrifugal Compressors: Work done and pressure rise; Slip; Compressibility effects; Compressor characteristics. Axial Flow Compressors: Stage pressure rise; Blockage in compressor annulus; Degree of reaction; 3-D flow; Stage performance; h-s diagram & efficiency; off design performance; Performance characteristics; Design process. Combustion System. Axial Flow Turbines : Stage performance; Degree of reaction; h-s diagram & efficiency; Vortex theory; Overall turbine performance; Performance characteristics; Blade cooling; Design process. Prediction of performance of simple gas turbines; Off Design performance; Gas turbine blade materials; matching procedure. Combined cycles: Differences between Single and combined Cycles, characteristics of combined cycles, Performance calculations for Combined Cycle.

SECTION - B

Thermodynamics Of Aircraft Jet Engines Theory of Jet Propulsion - Thrust and efficiency - Ram Jet - Turbojet and Turbofan engines - Turboprop and Turboshift Engines – Thrust augmentations - Typical engine performance - Engine - Aircraft matching. Aero-Thermodynamics Of Jet Propulsion Subsystems Subsonic inlets - Supersonic inlets - Gas turbine combustors - After burners and Ramjet Combustors -Supersonic Combustion - Exhaust Nozzles.

TEXT BOOKS :

1. Philip G. Hill and Carl R. Peterson, Mechanics and Thermodynamics of Propulsion, Second Edition,
2. Bonney E.A. Zucrow N.J. Principles of Guided Missile Design, Van Nostranc Co., 1985.
3. S.M. Yahya, Gas Dynamics and Jet Propulsion.

REFERENCE BOOKS :

1. Addition - Wesley Publishing Company, New York, 1992.
2. Zucrow N.J. Principles of Jet Propulsion and Gas Turbines, John Wiley and Sons Inc, New York, 1970.
3. Zucrow N.J. Aircraft and Missile Propulsion, Vol.I and Vol.II, John Wiley and Sons Inc, New York, 1975.

ELECTIVE -III

2MTE5 (1) FUEL & COMBUSTION

SECTION - A

Introduction General, Conventional Energy Sources, Solar Energy, Nuclear Power, Energy from Biomass, Wind Power, Tidal Power, Geothermal Energy, Energy Survey of India, Rocket Fuels Solid, Liquid & Gaseous Fuels General, Family of Coal, Origin of Coal, Gasification of Coal, Analysis and Properties of Coal, Action of Heat on Coal, Classification of Coal, Oxidation of Coal, Hydrogenation of Coal, Efficient use of Solid Fuels. Manufactured Fuels, Agro Fuels, Solid Fuel Handling, Properties Related to Combustion, Handling Storage Theory Of Combustion Process Origin and Classification of Petroleum, Refining and Other Conversion Processes, Composition of Petroleum with respect to Combustion, Property & Testing of Petroleum Products, Various Petroleum Products, Nature of Indian Crudes & Petroleum Refining in India, Liquid Fuels from Other Sources, Storage and Handling of Liquid Fuels, Liquid Fuels Combustion Equipment. Types of Gaseous Fuels, Natural Gases, Methane from Coal Mines, Manufactured Gases, Producer Gas, Water Gas, Carburetted Water Gas, Blast Furnace Gas Fuels, Through Non-Thermal Route - Biogas, Refinery Gas, LPG, Cleaning and Purification of Gaseous Fuels.

SECTION - B

Stoichiometry Stoichiometry and Thermodynamics, Combustion Stoichiometry General, Rapid Methods of Combustion Stoichiometry, Combustion Thermodynamics, Problem, Combustion Problems with Chemical Reactions Burners Stoichiometry Relations, Theoretical Air Required for Complete Combustion, Calculation of Minimum Amount of Air Required for a Fuel of known Composition, Calculation of Dry Flue Gases if Fuel Composition is Known, Calculation of the Composition of Fuel & Excess Air Supplied, from Exhaust Gas Analysis, Dew Point of Products, Flue Gas Analysis (O₂, CO₂, CO, NO_x, SO_x). Burner Design Ignition, Concept of Ignition, Auto Ignition, Ignition Temperature. Flame Propagation, Various Methods of Flame Stabilization, Incorporation in Burner Design, Basic Features and Types of Solid, Liquid and Gaseous Fuel Burner, Design Consideration of Different Types of Coal - Oil and Gas Burners, Recuperative & Regenerative Burners

TEXT BOOKS :

1. Samir Sarkar, Fuels & Combustion, 2nd Edition, Orient Longman, 1990
2. Bhatt ,vora Stoichiometry, 2nd Edition, Tata Mcgraw Hill, 1984
- 3.. Sharma SP, Mohan Chander, Fuels & Combustion, Tata Mcgraw Hill, 1984

REFERENCE BOOKS :

1. Blokh AG, Heat Transfer in Steam Boiler Furnace, Hemisphere Publishing Corpn, 1988
2. Civil Davies, Calculations in Furnace Technology, Pergamon Press, Oxford, 1966

Websites:

<http://shop.ieee.org>.

<http://opus.utah.edu>

<http://www.creada.org>

ELECTIVE-III

2MTE5 (2) SOLAR ENERGY

SECTION -A

Radiative Properties and Characteristics of Materials Reflection from ideal specular, ideal diffuse and real surfaces, Selective Surfaces: Ideal coating characteristics; Types and applications; Anti- reflective coating; Preparation and characterization. Reflecting Surfaces and transparent materials. Solar Thermal Energy Storage

Types: Sensible storage; Latent heat storage; Thermo-chemical storage. Design of storage System. Solar Thermal Energy system: Solar still; Solar cooker: Solar pond; Solar passive heating and cooling systems: Trombe wall; Greenhouse technology: Fundamentals, design, modeling and applications.

PHOTOVOLTAIC SOLAR CELL:P:N Junction - Metal - Schottky Junction, Electrolyte – Semiconductor Junction, Types of Solar Cells - their Applications - Experimental Techniques to determine the Characteristics of Solar Cells - Photovoltaic Hybrid Systems Photovoltaic Thermal Systems – Storage Battery - Solar Array and their Characteristics Evaluation - Solar Chargeable Battery. Solar Energy for Industrial Process Heat Industrial process heat: Temperature requirements, consumption pattern; Applications of solar flat plate water heater & air heater for industrial process heat; Designing thermal storage; Transport of energy.

SECTION-B

Solar Heating & Cooling System Solar water heating systems, Liquid based systems for buildings, Solar air heating systems, Methods of modeling and design of Solar heating

system, Cooling requirements of buildings, Vapour absorption refrigeration cycle; Water, ammonia & lithium bromide-water absorption refrigeration systems; Solar desiccant cooling. Performances of solar collectors ASHRAE code; Modeling of solar thermal system components and simulation; Design and sizing of solar heating systems: f – chart method and utilizability methods of solar thermal system evaluation; Development of computer package for solar heating and cooling applications; Flat-plate Collectors Energy balance for Flat Plate Collectors; Thermal analysis; Heat capacity effect; Testing methods; Types of Flat Plate Collectors: Liquid Flat Plate Collectors, Air flat-plate Collectors- Thermal analysis; Evacuated tubular collectors. Concentrating Collector Designs Classification, design and performance parameters; Tracking systems; Compound parabolic concentrators; Parabolic trough concentrators; Concentrators with point focus; Heliostats; Comparison of various designs: Central receiver systems, parabolic trough systems; Solar power plant; Solar furnaces

TEXT BOOKS :

1. S.P.Sukhatme-Solar Energy: principles of Thermal Collection and Storage, Tata McGraw-Hill
2. J.A.Duffie and W.A.Beckman-Solar Engineering of Thermal Processes-John Wiley, (1991).

REFERENCE BOOKS :

J.F.Kreider and F.Kreith-Solar Energy Handbook McGraw-Hill (1981).

ELECTIVE -III 2MTE5 (3) MECHATRONICS

SECTION - A

Introduction: Scope, sensors, transducers, selection, contact & non contact optical types, performance, examples. Actuators : Principal, types-hydraulic, pneumatic, electrical, contact speed, multispeed, step and continuous variable, actuators with stepping motors.

Computer process controls : Computer process interface, interface hardware, direct digital control, supervisory computer control. Design of mechatronics elements: Measuring system, control software and user interface, gauging, tool monitoring system, spindle drives, feed drives, servo principles, configuration CNC systems, interfacing, monitoring, diagnostics. Automatic loading and unloading devices, magazines, bunkers, orientors, feeders, separators, etc.

SECTION - B

Pneumatic systems: Different control components of pneumatic systems and there conversion valves, auxiliary devices, synchronizing, clamping, declamping, application to robotics.

Hydraulic systems: Different control components of hydraulic systems, valves and auxiliary devices, design and analysis of hydraulic circuits sequencing, synchronizing, pneumo-hydraulic, CNC lubrication, machine tool applications.

TEXT BOOKS :

1. Industrial Automation by Turgam, Mir Publication.
2. Pneumatics and Hydraulics by Stewar

REFERENCE BOOKS :

1. Mechatronics by HMT
2. Introduction to Mechatronics and Measurment Systems by Michal B. Histan & David G. Aiciatore.

ELECTIVE -III
2MTE5 (4) COMPUTATIONAL FLUID DYNAMICS

SECTION – A

Review of Governing Equations: Governing Equations of Fluid flow and heat transfer, review of numerical methods. Discretization: Introduction to finite differences, difference equations, explicit and implicit approaches: definition and contrasts, errors and analysis of stability. Classification of Partial Differential Equations: Explicit and Implicit methods, solution of select model equations; Laplace heat and wave equation, laminar boundary layer solution

SECTION - B

CFD Techniques: The lax -wendroff technique, Mac Cormack's technique, Relaxation technique and its use with low speed inviscid flows, aspects of numerical dissipation and dispersion; artificial viscosity, Alternating Direction Implicit (ADI) technique, pressure correction technique with application to incompressible viscous flow. Initial And Boundary Value Problems: Free falling of a spherical body, two dimensional motions of a body through a fluid radial flow.

TEXT BOOKS :

1. Computational Fluid Flow and Heat Transfer, Muralidhar, K. and Sundararajan, T., Narosa Pub., 2004.
2. Computational Fluid Dynamics: The Basics with Applications, Anderson, J. D., Jr. McGraw Hill, 2002.
3. Computational Fluid Dynamics: An Introduction for Engineers, Abbot, M. B. and Basco, D. R., John Wiley & Sons, 2006.
4. Computational Fluid Dynamics: Principles and Applications, Blazek, J., Elsevier Science, 2001.

THIRD SEMESTER
3 MTES Seminar & Dissertation

FOURTH SEMESTER
4MTEP Seminar & Dissertation
As per given scheme