DETAILED SYLLABUS OF M.TECH (HEAT TRANSFER & ENERGY STUDIES) DAY TIME COURSE WITH EFFECT FROM 2019-2020 ACADEMIC YEAR

FIRST SEMESTER WITH EFFECT FROM 2019-20

MTHT 101 Mathematical Methods in Engineering

Periods per week : 4 Examination : 70 ; Sessionals : 30
Examination (Theory): 3hrs. Credits : 3

System of Simultaneous Equations:- Consistency of Linear System of equations (Non-homogeneous and Homogeneous), Solving Linear system of equations: Gauss Elimination Method, Gauss-Jordan Method , Numerical methods, Jacobs Gauss-Seidal method, LU factorization method, Characteristic equation, Eigen Values and Eigen Vectors of a Matrix, their properties. finding the largest Eigen Value of a matrix, Rayleigh's power method.

Numerical Solution of Ordinary Differential Equations:- Picard's Method, Taylor's Series, Euler's Method, Modified Euler's Method, Runge- Kutta Method (2^{nd} and 4^{th} orders), Milne's Predictior-Corrector Method.

Applications of Partial Differential equations:- Method separation of variables, PDE's of Engineering , vibrations of a stretched string wave equation, one dimensional heat flow, two dimensional heat flow in the steady state, solution of Laplace equation in Cartesian and polar co-ordinates.

Numerical Solutions of Partial Differential Equations:- Classification of second order PDE's, elliptic equations, solution of Laplace's equation and Poisson's equation using Jacob and Gauss-Seidal methods, Parabolic equations, solution of heat equation, Schmidt explicit formula, Crank-Nicolson formula, Bendre- Schmidt recurrence relation, Hyperbolic equations, solution of Wave equation.

Reference Books:

1. Higher Engineering Mathematics – B. S. Grewal, Khanna Publishers.
2. Introductory methods of Numerical Analysis – S. S. Sastry, Prentice Hall Publications.
3. Numerical methods in Engineering and Science by B.S. Grewal, Khanna Publishers.
4. Advanced Differential equations – M. D. Raisinghania, S. Chand & Co., Publications.

FIRST SEMESTER WITH EFFECT FROM 2019-20

MTHT 102 Conduction and Radiation Heat Transfer

Periods per week : 4 Examination : 70 ; Sessionals : 30
Examination (Theory): 3hrs. Credits : 3

Conduction: heat equation in Cartesian, cylindrical and spherical coordinates –Steady one dimensional heat conduction with and without heat generation in different geometries, thermal resistance network, composite systems, effect of variable thermal conductivity, heat transfer in common configurations, conduction shape factor. Steady two dimensional heat conduction: solution by method of separation of variables.
Extended surfaces heat transfer: different fin geometries, differential equation for fin of uniform and variable cross sections, solution of fin equation for different boundary conditions, fin performance.
Transient conduction: lumped system analysis, transient conduction in various geometries, one term approximate solutions, use of Heisler's charts, semi infinite solids, transient conduction in multi dimensional systems: product solution for transient conduction in various geometries, Conduction with phase change - integral method, solidification and melting - numerical methods.

Radiation: Review of radiation principles - laws of thermal radiation - surface properties - radiative heat exchange among diffuse, gray and non-gray surfaces separated by non-participating media - gas radiation and radiation transfer in enclosures containing absorbing and emitting media - interaction of radiation with conduction and convection.

References:

1. Analysis of heat and mass transfer by Eckert and Drake, McGraw-Hill
2. Fundamentals of heat transfer by Grober, Erk and Grigull, McGraw-Hill
3. Fundamentals of heat transfer by Incropera and Hewitt
5. Conduction heat transfer by Schneider, Eddison Wesley
6. Radiation heat transfer by Sparrow and Cess, McGraw-Hill
7. Radiation heat transfer by H.C. Hottel and A.F. Sarofin
8. Thermal radiation by Siegel and Howell.

FIRST SEMESTER WITH EFFECT FROM 2019-20

MTHT 103 Advanced Fluid Mechanics

Periods per week : 4 Examination : 70 ; Sessionals : 30
Examination (Theory): 3hrs. Credits : 3

Ideal and non-ideal flows, General equations of fluid motion, Navier-Stokes equations and their exact solutions, Boundary layer theory, solutions to flow over external surfaces, flow thorough internal surfaces, integral methods, steady laminar and turbulent incompressible flows, Introduction to compressible viscous flows, governing equations, Fanno and Rayleigh lines, normal and oblique shocks

Reference books:

1. Boundary layer theory, Schlichting by McGraw Hill
2. Foundations of fluid mechanics by Yuan, Prentice Hall
3. Turbulence, Bradshaw by Springer-Verlag

FIRST SEMESTER WITH EFFECT FROM 2019-20

MTHT 104 Measurements in Heat Transfer

Periods per week : 4 Examination : 70 ; Sessionals : 30
Examination (Theory): 3hrs. Credits : 3

Analysis of experimental data: Causes and types of experimental errors, Error analysis on a commonsense basis, Uncertainty analysis, Statistical analysis of experimental data probability distributions, The Gaussian or normal error distribution, Probability graph paper, The Chi-square test of goodness of fit, Method of least squares, Standard deviation of the mean, Graphical analysis and curve fitting, General considerations in data analysis.

Basic electrical measurements and sensing devices - Transducers, The variable - Resistance transducers, The differential transformer (LVDT), Capacitive transducers, Piezoelectric transducers, Photoelectric effects, Photoconductive transducers, Photovoltalic cells, Ionization transducers, Magnetometer search coil: Hall-effect transducers.

Pressure measurement: Dynamic response considerations, Mechanical pressure - Measurement devices, Dead-weight tester, Bourdon-tube pressure gauge, Diaphragm and bellows gauges, The Bridgman gauge, Low-pressure measurement. The Mcleod gauge, Pirani thermal-conductivity gauge, The Knudsen gauge, The ionization gauge, The alphatron.

Flow measurement: Positive displacement methods flow - Obstruction methods, Practical consideration for obstruction meters, The sonic nozzle. Flow measurement by drag effects, Hot-wire and hot-film anemometers, Magnetic flow meters, Flow- visualization methods, The shadowgraph, The schlieren, The interferometer, The Laser Doppler Anemometer (LDA), Smoke methods, Pressure probes, Impact pressure in supersonic flow.

The measurement of temperature: Temperature scales. The ideal-gas thermometer, Temperature measurement by mechanical effect. Temperature measurement by electrical effects, Temperature measurement by radiation, Effect of heat transfer or temperature measurement, Transient response of thermal systems, Thermocouple compensation, Temperature measurements in high-speed flow.

Thermal and transport Property measurement: Thermal conductivity measurements, Thermal conductivity of liquids and gases, Measurement of viscosity, Gas diffusion, Calorimetry, Convection heat-transfer measurements. Humidity measurements, Heat-flux meters.

Thermal radiation measurements: Detection of thermal radiation, Measurement of emissivity, Reflectivity and transmissivity measurements, Solar radiation measurements.

Reference books:

1. Experimental Methods for Engineers by Holman, J.P.
2. Mechanical Measurements by Thomas G. Beckwith, N. Newis Buck.
3. Measurements in Heat Transfer by Eckert and gold stein.

FIRST SEMESTER WITH EFFECT FROM 2019-20

MTHT 105 Elective Subject – I

A) ADVANCED OPTIMIZATION TECHNIQUES

Periods per week : 4 Examination : 70 ; Sessionals : 30
Examination (Theory): 3hrs. Credits : 3

Geometric programming (G.P): Solution of an unconstrained geometric programming, differential calculus method and arithmetic method. Primal dual relationship and sufficiency conditions. Solution of a constrained geometric programming problem (G.P.P), Complementary Geometric Programming (C.G.P)

Dynamic programming(D.P): Multistage decision processes. Concepts of sub optimization and Principal of optimality, computational procedure in dynamic programming calculus method and tabular methods. Linear programming as a case of D.P. and continuous D.P.

Integer programming(I.P): Graphical representation. Gomory's cutting plane method. Bala's algorithm for zero-one programming problem. Branch-and-bound method, Sequential linear discrete Programming, Generalized penalty function method.

Stochastic Programming (S.P): Basic Concepts of Probability Theory, Stochastic Linear programming.

Non-traditional optimization techniques: Multi-objective optimization - Lexicographic method, Goal programming method, Genetic algorithms, Simulated annealing, Neural Networks based Optimization.

References:

1. Operations Research- Principles and Practice by Ravindran, Phillips and Solberg, John Wiely
2. Introduction to Operations Research by Hiller and Lieberman, Mc Graw Hill
3. Engineering Optimization - Theory and Practice by Rao, S.S., New Age International (P) Ltd. Publishers.
4. Engineering Optimization By Kalyanmanai Deb, Prentice Hall of India, New Delhi.
5. Genetic Algorithms - In Search, Optimization and Machine Learning by David E. Goldberg, Addison-Wesley Longman (Singapore) Pvt. Ltd.

FIRST SEMESTER WITH EFFECT FROM 2019-20

MTHT 105 Elective Subject – I

B) ENERGY MANAGEMENT

Periods per week : 4 Examination : 70 ; Sessionals : 30
Examination (Theory): 3hrs. Credits : 3

Introduction: Energy Scenario – World and India, Energy Resource Availability in India, Energy Consumption, Energy intensive industries – an overview, Need for Energy Conservation, Role of Energy manager, Principles of Energy Management. Energy conservation Act 2003.

Instruments for Energy auditing: Instrument characteristics – sensitivity, readability, accuracy, precession, hystersis, Error and Calibration, Measurement of Flow, Velocity, Pressure, Temperature, Speed, Lux, Humidity, Analysis of stack, Water quality, Fuel quality and Power

Energy Audit: Definition and Concepts, Types of Energy Audits – Basic Energy Concepts – Energy audit questionnaire, Data Gathering – Analytical Techniques. Energy Consultant: Need of Energy Consultant – Consultant Selection Criteria

Energy Conservation: Technologies for Energy Conservation – energy flow networks – critical assessment of energy usage – Boilers, Thermic fluid heater, Furnaces, Waste heat recovery systems, Thermal storage systems, Steam traps, Refractories, Insulation - Optimum thickness

Synthesis of alternative options and technical analysis of options, Process integration.

Economic Analysis: Scope, Characterization of an Investment Project – Types of Depreciation – Time Value of money – budget considerations, Risk Analysis.

Methods of Evaluation of Projects: Payback – Annualized Costs – Investor's Rate of return – Present worth – Internal Rate of Return – Pros and Cons of the common methods of analysis – replacement analysis.

Text Books:

1. Energy Management Hand book by W.C. Turner (Ed)
2. Management by H.Koontz and Cyrill O Donnell
3. Financial Management by S.C. Kuchhal
4. Energy Management by W.R.Murthy and G.Mc Kay
5. Hamies, Energy Auditing and Conservation. Methods and Measurements, Management and Case study, Hemisphere, Washington, 1980
6. Energy Management by Trivedi, PR, Jolka KR, Commonwealth publication, New Delhi
7. Guide book for National Certificate Examination for Energy Managers and Energy Auditors (Could be downloaded from www.energymanagertraining.com)

REFERENCE:

1. Energy Management/W.R.Murphy, G.Mckay/Butterworths.
2. Energy Management Principles/C.B.Smith/ Pergamon Press.

3. Energy Economics/A.V.Desai/Wieley Eastern
Industrial Energy Management and Utilization/L.C. Witte, P.S. Schmidt, D.R. Brown/ Hemisphere Publication/Washington

FIRST SEMESTER WITH EFFECT FROM 2019-20

MTHT 105 Elective Subject – I
C) ADVANCED FINITE ELEMENT ANALYSIS

Periods per week : 4 Examination : 70 ; Sessionals : 30
Examination (Theory): 3hrs. Credits : 3

Introduction, Finite elements of an elastic continuum - displacement approach, generalization of the finite element concept - weighted residuals and variational approaches. Plane stress and plane strain, Axisymmetric stress analysis, 3-D stress analysis.
Element shape functions - Some general families of C continuity, curved, isoparametric elements and numerical integration. Some applications of isoparametric elements in two-and-three dimensional stress analysis.
Bending of thin plates - A C continuity problem. Non-conforming elements, substitute shape functions, reduced integration and similar useful tricks. Lagrangian constraints in energy principles of elasticity, complete field and interface variables (Hybrid method).
Shells as an assembly of elements, axisymmetric shells, semi-analytical finite element processes - Use of orthogonal functions, shells as a special case of 3-D analysis. Steady-state field problems - Heat conduction, electric and magnetic potentials, field flow.
The time domain, semi-descritization of field and dynamic problems and analytical solution procedures. Finite element approximation to initial value - Transient problems.

Reference books:
1. The Finite Element Method by Zienkiewicz, O.C.
2. The Finite Element Methods in Engineering by Rao, S.S.
3. Concepts and Applications of Finite Element Analysis by Cook, R.D.
4. Applied Finite Element Analysis by Segerland, L.J.

FIRST SEMESTER WITH EFFECT FROM 2019-20
MTHT 106 SOLAR ENERGY

Periods per week : 4 Examination : 70 ; Sessionals : 30
Examination (Theory): 3hrs. Credits : 3

Current alternate energy sources - thermodynamic view point and conversion methods. Solar Radiation, direct and diffuse radiation, measurement and estimation.
Components of solar energy systems, collector performance. Radiation and meteorological data processing, long term conversion factors. Water and air heating collectors. Concentrating collectors design procedure. Storage systems.
System configurations and system performance prediction, simulations, solar thermal systems applications to power generation, heating and cooling. Solar passive devices : solar stills, ponds, greenhouse, dryers. Trombe wall, overhangs and winged walls, **Solar Economics**.

Reference books:

1. Principles of solar engineering – Kreith and Kerider
2. Solar energy thermal processes – Duffie and Beckman
3. Solar energy – Sukhatme
4. Solar energy – Garg
5. Solar energy – Magal
6. Solarr energy – Tiwari and Suneja
7. Power plant technology – El Wakil

FIRST SEMESTER WITH EFFECT FROM 2019-20
MTHT 107 THERMO FLUIDS LAB- I

Periods per week : 3 Examination: 50 Sessionals : 50
Credits : 1.5

List of Experiments:
1. Stream line flows of various geometries on laminar flow table.
2. Temperature distribution and efficiency of an extended surface.
3. Unsteady state heat transfer of a cylindrical specimen.
4. Solar radiation on thermal energy storage training system.
5. Overall heat transfer coefficient of a shell and tube heat exchanger.
6 Steady state unidirectional heat transfer on a metal bar.

FIRST SEMESTER WITH EFFECT FROM 2019-20
MTHT 108 COMPUTATIONS LAB- I

Periods per week : 3 Examination: 50 Sessionals : 50
Credits : 1.5

List of Experiments:

EXERCISE-I:
Solution of I order differential equation with Fourth order Runge - Kutta method.
Given $(dy/dx)=(3x^2/2y)$ with $x_0=0$ and $y_0=y(0)=1$.

EXERCISE-II:
Solution of a system of two first order differential equations using Fourth order Runge-Kutta method.
Given $(dy/dx) = (z-x)$ and $(dz/dx) = (x+y)$ with $x_0 = 0$ & $y_0 = 1$, $z_o = 1$.

EXERCISE-III:
Solution of II order differential equations with Fourth order Runge-Kutta method.
Given:$(d^2y/dx^2) = (y+x)$ and $(dy/dx) = z$, $x_i = 0, x_f = 1$, $h = (x_f-x_i)/10$.

EXERCISE-IV:
Solution for two dimensional steady state heat conduction in a slab using the Jocobi method .

EXERCISE-V:
Solution for two dimensional steady state heat conduction in a slab using the Gauss-siedel method .

EXERCISE-VI:
Solution for two dimensional steady state heat conduction in a slab using the successive over relaxation method.

EXERCISE-VII:
Solution for unsteady state heat conduction in a slab using crank-Nicolson method and Thomas algorithm. (Solution of parabolic equation).

EXERCISE-VIII:
Solution for unsteady state heat transfer in a circular disc using crank-Nicolson method and Thomas algorithm.

EXERCISE-IX:
Solution for unsteady state heat transfer in a circular fin using Crank-Nicholson and Thomson algorithm.

SECOND SEMESTER WITH EFFECT FROM 2019-20
MTHT 201 CONVECTION HEAT TRANSFER

Periods per week : 4 Examination : 70 ; Sessionals : 30
Examination (Theory): 3hrs. Credits : 3

Derivation of equations of conservation of mass, momentum and energy, boundary layer approximations, similarity solutions for laminar boundary layer over flat plate, integral methods, forced convection in turbulent flows, eddy diffusivity, momentum and energy equation in turbulent shear layer, analogy between momentum and heat transfer, liquid metal heat transfer, natural convection from a vertical plate and cylinders, free convection in enclosed spaces, combined free and forced convection, heat transfer in MHD systems, transpiration cooling.

Reference books:

1. Analysis of heat and mass transfer by E.R.G. Eckert and Robert M. Drake, McGraw Hill
2. Boundary layer theory by Schlichting
3. Heat transfer by Gebhart
4. Natural convection heat and mass transfer by Y. Jaluria , Pergamon press
5. Convective heat and mass transfer by Kays, W.M., and Crawford, M.E., McGraw Hill

SECOND SEMESTER WITH EFFECT FROM 2019-20
MTHT 202 THERMAL ENVIRONMENTAL CONTROL

Periods per week : 4 Examination : 70 ; Sessionals : 30
Examination (Theory): 3hrs. Credits : 3

Introduction: Thermodynamic consideration, Heat transfer considerations: Refrigeration. Vapour compression cycles, Refrigerants, Absorption refrigeration; Psychromatrices: Thermodynamic properties of moist air; Psychrometric charts, Cooling towers and evaporators - Condensers - Cooling and Dehumidifying coils, Air conditioning calculations.

References:

1. Thermal Environmental Engineering by Threkled, J.L.
2. Refrigeration and Air conditioning by Stoker, W.F.

SECOND SEMESTER WITH EFFECT FROM 2019-20
MTHT 203 DESIGN OF THERMAL EQUIPMENT

Periods per week : 4 Examination : 70 ; Sessionals : 30
Examination (Theory): 3hrs. Credits : 3

Classification of heat exchangers; basic design methods for heat exchangers, double pipe heat exchangers, parallel and counter flow, design of shell and tube heat exchangers; TEMA codes; flow arrangements for increased heat recovery; condensation of single vapors, mixed vapors; design considerations for different plate type heat exchangers; regenerators, steam generators, condensers, radiators for space power plant, cooling towers, power plant heat exchangers, furnace calculations.

Reference books:

1. Process heat transfer by Donald Kern, Tata McGraw Hill Publishing Company Ltd.
2. Heat Exchanger Selection, Rating and Thermal Design by Sadic Kakac and Hongton Liu, CRC Press
3. Process Heat Transfer by Sarit Kumar Das, Narosa Publishing House Pvt.Ltd.
4. Heat exchanger design by Press and N. Ozisik
5. Standards of the Tubular Exchange Manufacturers Association, TMEA, New York
6. Heat Exchangers by Kakac, S., A.E. Bergles and F. Mayinger (Eds.) Hemisphere, 1981
7. Compact Heat exchangers by Kays, W.M., and A.L. London, McGraw Hill

SECOND SEMESTER WITH EFFECT FROM 2019-20
MTHT 204 BOILING AND TWO-PHASE FLOW HEAT TRANSFER

Periods per week : 4 Examination : 70 ; Sessionals : 30
Examination (Theory): 3hrs. Credits : 3

Definitions: Types of flow; volumetric concentration; void fraction; volumetric flux; relative velocity; drift velocity; flow regimes; flow maps; analytical models.
Homogeneous flow: One-dimensional steady homogeneous equilibrium flow; homogeneous friction factor; turbulent flow friction factor
Separated flow: Slip; Detailed discussion on bubbly, slug and annular flow; Lockhart-Martinelli method foe pressure drop calculation; pressure drop for flow with boiling; flow with phase change.
Drift flow model: General theory; gravity flows with no wall shear; correlation to simple theory; Armond or Bankoff flow parameters.
Boiling: Regimes of boiling; nucleation; growth of bubbles; bubble motion at a heating surface; heat transfer rates in pool boiling; Rohsenow correlation for nucleate boiling. Zuber's theory for critical heat flux. Bromley theory for film boiling; forced convection boiling; Chen's correlation for flow boiling; maximum heat flux or burn out.
Condensation: Nusselt's theory; boundary layer treatment of laminar film condensation; experimental results for vertical and horizontal tubes; condensation inside a horizontal tube.

Reference books:

1. One-dimensional two-phase flow by Wallis, McGraw-Hill
2. Two-phase flow and heat transfer by Butterworth and Hewitt, Oxford
3. Convective boiling and condensation by J.G. Collier, McGraw-Hill
4. Boiling heat transfer and two phase flow by L.S. Tong, John Wiley
5. Transport processes in boiling and two-phase flow systems by Hsu and Graham, McGraw Hill

SECOND SEMESTER WITH EFFECT FROM 2019-20

MTHT 205 Elective Subject – II

A) THERMAL AND NUCLEAR POWER PLANTS

Periods per week : 4 Examination : 70 ; Sessionals : 30
Examination (Theory): 3hrs. Credits : 3

Introduction – Sources of Energy, types of Power Plants, Direct Energy Conversion System, Energy Sources in India, Recent developments in Power Generation. Combustion of Coal, Volumetric Analysis, Gravimetric Analysis, Flue gas Analysis.

Steam Power Plants: Introduction – General Layout of Steam Power Plant, Modern Coal-fired Steam Power Plants, Power Plant cycles, Fuel handling, Combustion Equipment, Ash handling, Dust Collectors.
Steam Generators: Types, Accessories, Feed water heaters, Performance of Boilers, Water Treatment, Cooling Towers, Steam Turbines, Compounding of Turbines, Steam Condensers, Jet & Surface Condensers.

Gas Turbine Power Plant: Cogeneration, Combined cycle Power Plants, Analysis, Waste-Heat Recovery, IGCC Power Plants, Fluidized Bed Combustion – Advantages & Disadvantages.

Nuclear Power Plants: Nuclear Physics, Nuclear Reactors, Classification – Types of Reactors, Site Selection, Methods of enriching Uranium, Applications of Nuclear Power Plants.
Nuclear Power Plants Safety: By-Products of Nuclear Power Generation, Economics of Nuclear Power Plants, Nuclear Power Plants in India, Future of Nuclear Power.

Economics of Power Generation**:** Factors affecting the economics, Load Factor, Utilization factor, Performance and Operating Characteristics of Power Plants. Economic Load Sharing, Depreciation, Energy Rates, Criteria for Optimum Loading, Specific Economic energy problems.

Power Plant Instrumentation**:** Classification, Pressure measuring instruments, Temperature measurement and Flow measurement. Analysis of Combustion gases, Pollution – Types, Methods to Control.
Reference Books:
1. Power Plant Technology / El Wakil.
2. Power Plant Engineering / P.C.Sharma / Kotaria Publications.
3. Power Plant Engineering / P.K. Nag / TMH.

SECOND SEMESTER WITH EFFECT FROM 2019-20

MTHT 205 Elective Subject – II
B) TURBO MACHINES

Periods per week : 4 Examination : 70 ; Sessionals : 30
Examination (Theory): 3hrs. Credits : 3

Definition and classification of turbo machines; principles of operation; specific work and its representation on T-s and h-s diagrams; losses and efficiencies; energy transfer in turbo machines; Euler equation of turbo machinery.

Flow mechanism through the impeller – velocity triangles, ideal and actual flows, slip and its estimation; degree of reaction - impulse and reaction stages; significance of impeller vane angle.

Similarity; specific speed and shape number; cavitations in pumps and turbines; performance characteristics of pumps and blowers; surge and stall; thin aerofoil theory; cascade mechanics

Steam turbines - flow through nozzles, compounding, effect of wetness in steam turbines; gas turbines; hydraulic turbines – Pelton, Francis and Kaplan turbines, draft tube, performance and regulation of hydraulic turbines.

Reference books:

1. Yahya, S. M., Turbines, Compressors and Fans, Tata McGraw-Hill, 1983.
2. Gopalakrishnan, G. and Prithviraj, D., Treatise on Turbo machines, Schitech Publications, 2002
3. Shepherd, D. G., Principles of Turbomachinery, Macmillan Publishing Company, 1957
4. Csanady, G. T., Theory of Turbomachines, McGraw-Hill, 1964.
5. Dixon, S. L., Fluid Mechanics, Thermodynamics of Turbomachinery, Third Edition, Pergamon Press, 1978.
6.Nechleba, M., Hydraulic Turbine, Arita, 1957.

SECOND SEMESTER WITH EFFECT FROM 2019-20

MTHT 205 Elective Subject – II
C) HYDEL POWER AND WIND ENERGY

Periods per week : 4 Examination : 70 ; Sessionals : 30
Examination (Theory): 3hrs. Credits : 3

Hydel Power: Stream flow data and water power estimates, use of hydrographs
Hydraulic turbine, characteristics and part load performance, design of wheels, draft tubes and penstocks, cavitation; plant layouts; costing of water power.
Wind Power and Engineering: Estimates of wind energy potential, wind maps; aerodynamic and mechanical aspects of wind machine design.
Wind tunnel simulations, conversion and storage methods; industrial applications. Instrumentation for wind velocity measurements

Reference books:

i. Non-Conventional Energy Systems by K.Mittal, Wheeler
ii. Non-Conventional Energy by Ashok V Desai, Wiley Eastern Publications
iii. Non-Convectional Energy Sources by G.D.Rai
iv. Renewable Energy Sources and Emerging Technologies by D.P.Kothari, K.C.Singal, Rakesh Ranjan, PHI Learning Pvt.Ltd
v. Wind Energy Engineering by Pramod Jain, Mc Graw Hill
vi. Wind Energy explained: Theory, Design and applications by James F Manwell, Jon G.Mc.Gowan and Anthony L Rogers, Wiley black well
vii. Introduction to Hydro Energy Systems by Wagner, Herman –Josef, Mathur,Jyotirmoy, Springer Verlog, Berlin.
viii. Hydro Electrical Energy, Tamra orr, Cherry lake Publishing.

SECOND SEMESTER WITH EFFECT FROM 2019-20
MTHT 206 THERMO FLUIDS LABS-2

Periods per week : 3 Examination: 50 Sessionals : 50
Credits : 1.5

List of Experiments:
1. Fluid friction of smooth pipes.
2. Evaluation of heat transfer on heat pipe demonstrator.
3. Solar radiation on solar concentrator training system.
4. Evaluation of output parameters of shell and tube heat exchanger.
5. Temperature distribution and efficiency of pin fin apparatus under forced convection.
6. Effective thermal conductivity of a lagged pipe

SECOND SEMESTER WITH EFFECT FROM 2019-20
MTHT 207 COMPUTATIONS LAB-2

Periods per week : 3 Examination: 50 Sessionals : 50
Credits : 1.5

List of Experiments:

EXERCISE-I:
Combustion calculations for solid and liquid fuels

EXERCISE-II:
Combustion calculations for gaseous fuels

EXERCISE-III:
Estimation of fin tip temperatures

EXERCISE-IV:
Efficiency of boilers and heaters based on field data

EXERCISE-V:
Pressure drop of saturated and super heated steam pipes

EXERCISE-VI:
Pressure drop of air and flue gas in tubes and pipes

EXERCISE-VII:
Pressure drop of air and flue gas over finned tubes

EXERCISE-VIII:
Heat transfer coefficient for steam inside tubes.

EXERCISE-IX:
Heat transfer coefficient for air and flue gas inside tubes

SECOND SEMESTER WITH EFFECT FROM 2019-20

MTHT 208 SEMINAR

Periods per week : 3 Examination: 50 Sessionals : 50
Credits : 1

A student has to give seminar on the topics related to his specialization.

SECOND SEMESTER WITH EFFECT FROM 2019-20

MTHT 301 Elective Subject – III
A) GAS DYNAMICS

Periods per week : 4 Examination : 70 ; Sessionals : 30
Examination (Theory): 3hrs. Credits : 3

Conservation laws for compressible flow, Concepts of compressible flow, Effect of Mach number on compressibility, Isentropic flow with variable area, Effect of area variation, Impulse function, Fanno flow - Variation of flow properties, Variation of Mach number with duct length, Isothermal flow with friction, Rayleigh flow - Variation of flow properties, Maximum heat transfer, Normal shock waves-Variation of flow properties, Prandtl Meyer relation, Rankine-Hugoniot relations, strength of shock wave, Oblique shock waves – Governing equations, Variation in flow properties, **Propulsion Systems**.

Reference books:

1. Fundamentals of Compressible flow with Aircraft and Rocket Propulsion, S.M.Yahya, New age International (P) Ltd., Publishers
2. Fundamentals of Compressible fluid dynamics, P.Balachandran, PHI Learning (P) Ltd.,
3. Gas Dynamics: Theory and Applications, George Turrel, John Wiley & Sons, 1997
4. Fundamentals of Gas dynamics, Robert D Zucker and Oscar Biblaz, John Wiley & Sons, 2002
5. Molecular gas dynamics: theory, techniques and application, Yoshio Sone Birk Hauser, Boston,
6. Applied Gas Dynamics, Ethirajan Rathakrishnan, John Wiley & Sons, 2010.

SECOND SEMESTER WITH EFFECT FROM 2019-20

MTHT 301 Elective Subject – III
B) GAS TURBINES AND JET PROPULSION

Periods per week : 4 Examination : 70 ; Sessionals : 30
Examination (Theory): 3hrs. Credits : 3

Thermodynamic cycle analysis of gas turbines; open and closed cycles, axial flow turbines, blade diagrams and design of blading, performance characteristics, **First-second and third laws of Thermodynamics**.
Centrifugal and axial flow compressors, blowers and fans, theory and design of impellers and blading, matching of turbines and compressors.
Fuels and combustion: effect of combustion chamber design and exhaust on performance, basic principles and methods of heat recovery.
Thermodynamic cycle analysis and efficiencies of propulsive devices, thrust equation, classification and comparison of ram jets, turbojets, pulse jets and rockets.
Performance of turbo-prop, turbo-jet and turbo-fan engines, augmentation of thrust.

Reference books:

1. Fundamentals of Turbo machines – Shephard
2. Practise on Turbomachines – G. Gopalakrishnan & D. Prithviraj, SciTech Publishers, Chennai.
3. Elements of Gas Dynamics – Yahya
4. Gas Turbines – Theory and practice – Zucrow
5. Turbines, Pumps, Compressors – Yahya
6. Axial Flow Compressors – Horlock.
7. Gas Turbines- Cohen, Roger & Sarvanamuttu

SECOND SEMESTER WITH EFFECT FROM 2019-20

MTHT 301 Elective Subject – III
C) ENVIRONMENTAL POLLUTION AND CONTROL

Periods per week : 4 Examination : 70 ; Sessionals : 30
Examination (Theory): 3hrs. Credits : 3

Air pollution - Classification and properties of Air pollutants - Sampling and analysis of air pollutants –Control of air pollution.

Dispersion of air pollutants - Gaussian plume model- Control of gaseous pollutants - Volatile organic compounds - Control of gaseous emission - Air pollution laws and standards.

Water pollution - Sampling and analysis of waste treatment – Advanced waste water treatments by physical, chemical, biological and thermal methods - Effluent quality standards.

Solid waste management - Classification and their sources - Health hazards - Handling of toxic and radioactive wastes - Incineration and verification.

Pollution control in process industries : Cement, Paper, Petroleum and petrochemical, Fertilizers and distilleries, thermal power plants and automobiles.

References:

1. Manster, G.M., Introduction to Engineering and Science, 2nd ed., Pearson Publishers, 2004.
2. Rao, E.S., Environmental Pollution Control Engineering, Wiley Eastern Ltd., 1991.
3. Mahajan, S.P., Pollution Control in Process Industries, Tata McGraw-Hill, 1985.
4. Crawford, M., Air Pollution Control Theory, TMH, 1976.

SECOND SEMESTER WITH EFFECT FROM 2019-20

MTHT 302 Elective Subject – IV
A) COMPUTATIONAL FLUID DYNAMICS

Periods per week : 4 Examination : 70 ; Sessionals : 30
Examination (Theory): 3hrs. Credits : 3

Classification of partial differential equations - Discretization methods - finite difference and finite volume formulations –classificatrion of PDES.
An overview of finite difference, finite element and finite volume methods. Numerical solution of parabolic partial differential equations using finite-difference and finite volume methods: explicit and implicit schemes, consistency, stability and convergence.
Numerical solution of systems of linear algebraic equations: general concepts of elimination and iterative methods, Gaussian elimination, Jacobi and Gauss-Seidel iterations, necessary and sufficient conditions for convergence of iterative schemes.
The finite volume method of discretization for diffusion problems: one dimensional steady diffusion problems, specification of interface diffusivity, source-term linearization. Discretization of transient one-dimensional diffusion problems. Solution of discretized equations using point and line iterations, strongly implicit methods and pre-conditioned conjugate gradient methods.
Numerical solution of the Navier-Stokes system for incompressible flows: stream-function vorticity and artificial compressibility methods.
Basics of grid generation- Numerical solution of hyperbolic equations - Burgers equation generation.
Reference books:

1. Tannehill, J.c., Anderson, D.A., and Pletcher, R.H., Computational Fluid Mechanics and Heat Tran5fer, 2nd ed., Taylor & Francis, 1997.
2. Numerical heat transfer and fluid flow – S.V. Patankar (Hemisphere Pub. House)
3. An Introduction to Computational Fluid Dynamics – FVM Method – H.K. Versteeg, W. Malalasekhara (PHI)
4. Peyret, R. and Taylor, T. D., Computational Methods for Fluid Flow, Springer- Verlag, 1983.
5. Computational Fluid Dynamics – Hoffman and Chiang, Engg Education System
6. Computational Fluid Dynamics – Anderson (TMH)
7. Computational Methods for Fluid Dynamics – Ferziger, Peric (Springer)
8. Computational Fluid Dynamics, T.J. Chung, Cambridge University
9. Computaional Fluid Dynamics – A Practical Approach – Tu, Yeoh, Liu (Elsevier)
   Text Book of Fluid Dynamics, Frank Chorlton, CBS Publishers.

SECOND SEMESTER WITH EFFECT FROM 2019-20

MTHT 302 Elective Subject – IV
B) RENEWABLE ENERGY SOURCE

Periods per week : 4 Examination : 70 ; Sessionals : 30
Examination (Theory): 3hrs. Credits : 3

SOLAR ENERGY COLLECTION AND ITS APPLICATIONS: Flat plate and concentrating collectors, Classification of concentrating collectors, Orientation and thermal analysis, Advanced collectors. Solar energy storage and applications: Different methods, Sensible, Latent heat and stratified storage, Solar ponds. Solar Applications- Solar heating and cooling technique, Solar distillation and drying, Photovoltaic energy conversion.

WIND ENERGY AND BIO-MASS: Sources and potentials, Horizontal and vertical axis windmills, Performance characteristics, Betz criteria, Bio- mass: Principles of Bio-Conversion, Anaerobic/aerobic Digestion, Types of Bio-gas digesters, Gas yield, Combustion characteristics of bio-gas, Utilization for cooking, I.C.Engine operation and economic aspects.

GEOTHERMAL ENERGY AND OCEAN ENERGY: Resources, Types of wells, Methods of harnessing the energy, Potential in India, Ocean Energy: OTEC, Principles of utilization, Setting of OTEC plants, Thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, Mini-hydel power plants, and their economics.

DIRECT ENERGY CONVERSION : Need for Direct Energy Conversion, Carnot cycle, Limitations, Principles of DEC, Thermo-electric generators, Seebeck, Peltier and Joule Thomson effects, Figure of merit, Materials, Applications, MHD generators, Principles, Dissociation and Ionization, Hall effect, Magnetic flux, MHD accelerator, MHD, Engine, Power generation systems, Electron gas dynamic conversion, Economic aspects. Fuel cells, Principles, Faraday's law's, Thermodynamic aspects, Selection of fuels and operating conditions.

Text Books:

1. Renewable Energy Resources by Tiwari and Ghosal, Narosa Publications..
2. Non-Conventional Energy Sources by G.D. Rai

References:

1. Renewable Energy Sources by Twidell & Weir
2. Solar Energy by Sukhatme
3. Solar Power Engineering by B.S Magal, Frank Kreith and J.F Kreith.
4. Principles of Solar Energy by Frank Krieth and John F Kreider.
5. Non-Conventional Energy by Ashok V Desai, Wiley Eastern Publications.
6. Non-Conventional Energy Systems by K Mittal , Wheeler.
7. Renewable Energy Technologies by Ramesh and Kumar, Narosa Publications

SECOND SEMESTER WITH EFFECT FROM 2019-20

MTHT 302 Elective Subject – IV
C) INTRODUCTION TO TURBULENCE

Periods per week : 4 Examination : 70 ; Sessionals : 30
Examination (Theory): 3hrs. Credits : 3

Laminar Turbulent Transition, Experimental Evidence, Fundamentals of Stability theory, the Orr-Sommerfeld equation, Curves of neutral stability and the indifference Reynolds number, Plate boundary layer, experimental confirmation, effects of pressure gradient, suction, compressibility and wall roughness, instability of the boundary layer for three dimensional perturbations.

Fundamental equations for mean motion, the k-equation, energy equation, boundary layer equations for plane flows; Internal flows, universal law of the wall, friction law, mixing length, fully developed internal flows, generalized law of the wall, pipe flow, slender channel theory.

Incompressible boundary layers, defect formulation, equilibrium boundary layers, boundary layer on a flat plate at zero incidence, boundary layers with separation, integral methods, field methods, thermal boundary layers; Compressible boundary layers, skin friction and Nusselt number, natural convection.

Free shear layers in turbulent flow, plane and axi-symmetric free jets, mixing layers, plane and axi-symmetric wakes, buoyant jets, plane wall jet; Turbulence modeling, zero equation, one equation and two equation models, derivation of the model equations, RNG model, DNS and large eddy simulation (LES).

Reference books:

1. Schlitching, H., Gersten, K., Boundary Layer Theory, Springer –Verlag, 2004.
2. Hinze, J. O., Turbulence, Second Edition, McGraw-Hill, 1975.
3. Biswas, G., Easwaran, V., (Eds.), Turbulent flows, Narosa Publishers, 2002.

THIRD SEMESTER WITH EFFECT FROM 2019-20

MTHT 303 INTERNAL ASSESSMENT OF PROJECT

Periods per week : 3 Viva : 100

Credits : 10

A student has to submit his proposal for his Project work, which includes the area of interest coupled with literature survey.

FOURTH SEMESTER WITH EFFECT FROM 2019-20

MTHT 401 EXTERNAL ASSESSMENT OF PROJECT

Total Marks: 100

Credits: 16

A student has to submit and defend his work in the presence of Expert Committee which includes external Examiner