DEPARTMENT OF MECHANICAL ENGINEERING
M. Tech (Thermal Engineering)
SCHEME OF INSTRUCTION AND EXAMINATION

(with effect from 2015-16 academic year)
I – SEMESTER

Code No.	Course title	Scheme of Instruction			Scheme of Examination			Total	Credits
		Lec.	Tut.	Total	Duration of Exam. (hrs)	Theory /Lab./ Viva	Sess.		
TE-1.1	Computation Methods in Engineering	4	--	4	3	70	30	100	4
TE-1.2	Computational Fluid Dynamics	4	--	4	3	70	30	100	4
TE-1.3	Measurements in Thermal Systems	4	--	4	3	70	30	100	4
TE-1.4	Advanced Thermodynamics	4	--	4	3	70	30	100	4
TE-1.5	Elective Subject-1 a) Advanced Heat Transfer b) Boiling and Two-Phase flow heat Transfer c) Advanced Optimization Techniques	4	--	4	3	70	30	100	4
TE-1.6	Elective Subject-2 a) Advanced Fluid Mechanics b) Solar Energy and Technology c) Tribology	4	--	4	3	70	30	100	4
TE-1.7	Lab 1: Fuels and Lubricants Laboratory	--	3	3	Viva-Voce	50	50	100	2
TE-1.8	Lab 2: CFD Laboratory		3	3	Viva-Voce	50	50	100	2
Total		**24**	**6**	**30**		**520**	**280**	**800**	**28**

Note : The viva-voce for the labs / seminars shall be held with the course instructor/ faculty member and an external examiner nominated by the university from any academic institution / industry / R & D organization.

II – SEMESTER

Code No.	Course title	Scheme of Instruction			Scheme of Examination			Total	Credits
		Lec.	Tut.	Total	Duration of Exam. (hrs)	Theory Lab./ Viva	Sess.		
TE-2.1	Thermal, Nuclear, Hydel, and OTEC Power Plants	4	--	4	3	70	30	100	4
TE-2.2	Energy Conservation in Thermal Systems	4	--	4	3	70	30	100	4
TE-2.3	Alternative Fuels and Advances in IC Engines	4	--	4	3	70	30	100	4
TE-2.4	Design of Thermal Equipment	4	--	4	3	70	30	100	4
TE-2.5	Elective Subject 1 a) IC Engine Combustion and Air-Pollution b) Steam turbines, Gas turbines and Jet Propulsion c) Mechatronics	4	--	4	3	70	30	100	4
TE-2.6	Elective Subject 2 a) Energy Management b) Refrigeration and Air-Conditioning c) Thermal Management of Electronic Equipment	4	--	4	3	70	30	100	4
TE-2.7	Lab-1:IC Engines and gas Turbine Laboratory	--	3	3	Viva-Voce	50	50	100	2
TE-2.8	Lab 2: Engine Combustion and Emissions Laboratory		3	3	Viva-Voce	50	50	100	2
Total		**24**	**6**	**30**		**520**	**280**	**800**	**28**

Note : The viva-voce for the labs / seminars shall be held with the course instructor/ faculty member and an external examiner nominated by the university from any academic institution / industry / R & D organization.

III – SEMESTER

Code No	Course title	Scheme of Examination	Total Marks	Credits
TE-3.1	Dissertation (Preliminary)	Viva-voce	**100**	**12**

Note : The Dissertation shall be evaluated through Viva–Voce examination by a committee with HOD, Chairman, Board of studies and Research Guide as members. The marks shall be awarded in the ratio of 30, 30, and 40 percent by the members respectively.

IV – SEMESTER

Code No	Course title	Scheme of Examination	Total Marks	Credits
TE-4.1	Dissertation (Final)	Viva-voce	**100**	**12**

Note: The Dissertation shall be evaluated through Defense and Viva–Voce examination by a committee with an External Examiner nominated by University, HOD, Chairman, Board of studies and Research Guide as members. The marks shall be awarded in the ratio of 20, 20, 20, and 40 percent by the members respectively.

FIRST SEMESTER

TE-1.1: COMPUTATIONAL METHODS IN ENGINEERING

Periods/Week: 4 Th. Ses.30 Exam: 70
Examination (Theory): 3 hrs. Credits: 4

Numerical Approximation: Errors and their computations: Absolute, relative and percentage errors-Error Propagations-A general error formula-Error in a series approximation.

Numerical solution of linear equations: Gauss Jacobi; Gauss Seidel iterative methods-method of least square for curve fitting. Eigen value problems

Interpolation Methods: Errors in polynomial interpolation-Finite differences: Forward, Backward, Central differences-Interpolation Formulae: Newton Forward formula, Newton Backward formula, Gauss, Stirling's, Bessel's, Everett's Formulae-Interpolation with unequal spaced points: Lagrange's interpolation, Newton's divided difference-Inverse interpolation.

Numerical Calculus: Numerical Differentiation (first & second order)-Errors in Numerical Differentiation-Maximum and Minimum values of a function-Numerical Integration: Trapezoidal rule, Simpson's rule, Weddle's rule-Numerical Double integration using trapezoidal and simpson's rule.

Numerical Solutions of Ordinary Differential Equations: Introduction to Initial and Boundary Value Problems-Numerical solutions of Ordinary Differential Equations: Taylor's series, Picards method of successive approximations, Euler's method, Modified Euler's method, Runge-Kutta methods (second and fourth orders). Boundary Value Problems: Finite Difference Method (FDM).

Numerical Solutions of Partial Differential equations: Classification of Second order equations-Finite difference approximation to derivatives-Elliptic equations –Solution of Laplace's equation: Liebmann's iteration process-Solution to Poisson's equation-Parabolic equations-Solution of one dimensional heat equation: Bender-Schmidt method, Crank Nicholson difference method-Solution of two dimensional heat equation: ADE method- Hyperbolic equations-Solution of one dimensional (I-D) wave equation.

References:

1. Numerical Methods for Engineers by Steven C. Chapra and Raymond P. Canale, 6th Edition, McGraw Hill Publications.
2. Numerical Methods in Engineering and Science by B.S. Grewal, 5th Edition, Khanna Publishers.
3. Introductory Methods of Numerical Analysis by S.S. Sastry, 4th Edition, PHI Learning Private Limited.
4. Numerical Methods by M.K. Jain, S.R.K. Iyengar, R.K. Jain, Revised 2nd Edition, New Age International (P) Ltd.

TE-1.2: COMPUTATIONAL FLUID DYNAMICS

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

Introduction: Finite difference method, finite volume method, finite element method, Philosophy of Computational Fluid Dynamics: Computational fluid dynamics: Why? – Computational fluid dynamics as a research tool – Computational fluid dynamics as a design tool – The impact of Computational fluid dynamics—some other examples; Automobile and engine applications; Industrial manufacturing applications; Civil engineering applications; Environmental engineering applications; Naval architecture applications (submarine example) - Computational fluid dynamics: What is it?. Governing equations and boundary conditions. Derivation of finite difference equations.

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.

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.
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, Eluer equations, Navier-stokes system of equations, flowfield-dependent variation methods, boundary conditions, example problems.
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.Chung, Cambridge University press, 2002
2. Introduction to Computational Fluid Dynamics – Niyogi.P, Chakrabartty S.K. and Laha.M.K., Pearson Education, India, 2005.
3. Computational Fluid Dynamics – The basics with Applications, John D. Anderson, Jr (TMH) & Mc Graw Hill, 1995.
4. An Introduction to Computational Fluid Dynamics – FVM Method – H.K. Versteeg, W. Malalasekhara, Longman Scientific and Technical, 1995 & PHI.
5. Text book of fluid dynamics, Frank Chorlton, CBS Publishers & distributors, 1985.

TE-1.3: MEASUREMENTS IN THERMAL SYSTEMS

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

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 measurements: 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 measurements: 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 measurements: 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.

References:

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.

TE-1.4: ADVANCED THERMODYNAMICS

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

Introduction: Macroscopic approach, First, Second, and 3rd law of thermodynamics, and its applications, thermodynamic potentials, generalized relations for Cp and Cv.

Thermodynamic relations and Entropy: Cyclic and reciprocity relations, general relations: Iso-thermal compressibility and coefficient of volume expansion. Concepts of entropy: entropy flow, entropy generation during heat transfer and thermodynamic processes, Gibbs and Helmholtz relations, Maxwell relations, T.dS equations, Heat capacity equation, entropy change, isentropic efficiency, T-s diagrams, effect of efficiency on compressor input, and nozzle exit velocity, entropy generation associated with heat transfer, Joule-Thomson coefficient, Clapeyron equation, Basic principles of liquefaction: Liquefaction of gases, Storage and uses of cryogenic fluids, Exergy: Reversible work/Maximum power output, Irreversibility, availability function, second law analysis and efficiency, change of exergy, and exergy destruction

Chemical Reactions: Fuels and combustion, elemental analysis of fuels, thermo-chemistry, combustion equations, reverse combustion analysis, evaluation of enthalpy of combustion, analysis of steady flow combustion, analysis of combustion in bomb, adiabatic flame temperature, reversible work associated with combustion and second law analysis of isothermal and adiabatic combustion

Power Cycles: Gas power cycles (efficiencies, mean effective pressure, comparison, application and limitations of): Carnot, Otto, Diesel, Dual, Atkinson, Miller, Stirling and Ericsson cycles; Gas turbine cycles: Brayton with regeneration, reheating, and inter-cooling, jet propulsion cycles, Lenoir cycle, Vapor power cycles: Rankine and effect of pressure and temperature on efficiency: reheat and regeneration cycles, binary vapor power cycles, combined gas-steam power cycles: cogeneration, second law analysis of gas and vapor cycles.

Thermodynamics of high speed gas flow: Stagnation properties, compression of high speed air and sound, Mach number and its applications, isentropic flow, air/gas flow through C-D duct/ nozzle, Tc and Pc in gas flow, back pressure, shock wave in C-D nozzle, flow through non-isentropic nozzles.

Reference Books:

- Advanced Thermodynamics for Engineers- Kenneth Wark Jr. McGraw-Hill Inc, New York, 1995
- Advanced Engineering Thermodynamics- Bejan A, 2/e, New-York, Wiley Interscience, 1997

- Thermodynamics *an engineering approach*- Yunus A Cengel, Michael A Boles, Tata-McGraw-Hill, ISBN:0-07-049503-3
- Internal combustion engines- V Ganesan, 2/e, Tata Mc Graw-Hill, ISBN:0-07-049457-6
- Fundamentals of Classical Thermodynamics- G. J. Van Wylen, R.E. Sonntag, 3/e, Jphn Wiley & Sons, New York, 1985
- Thermodynamics - K Wark and D.E.Richards, 6/e, McGraw-Hill, New York, 1999
- Introduction to Chemical Engineering Thermodynamics- Smith. J.M, and Van Ness, 4/e, McGraw-Hill, 1987
- Thermodynamics- J.P.Holman, 3/e. McGraw-Hill Inc, New York, 1980
- Engineering Thermodynamics (5/e) - P K Nag
- Chemical Engineering Thermodynamics- Y V C Rao

TE-1.5: ADVANCED HEAT TRANSFER

(Elective-I)

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

Brief Introduction to different modes of heat transfer: Conduction- General heat conduction equation- Boundary conditions- One dimensional heat transfer with internal heat generation- Fins- Transient heat conduction- Lumped system analysis- Heisler charts- Semi infinite solid- Use of shape factors in conduction.

Finite difference method: One dimensional steady state heat conduction- Boundary conditions– Two dimensional steady state heat conduction- Cylindrical and spherical geometry- unsteady state heat conduction- Implicit and explicit methods.

Convection: Equation of momentum and energy- integral solution of momentum and energy equations- Exact solutions- Boundary layer- Forced convection- External and internal flows- calculation of heat transfer coefficient for different geometries.

Free convection for different geometries: Combined free and forced convection. Boiling and condensation: Boiling curve- Correlation- Nusselt's theory of film condensation.

Radiation mechanism:- Radiant heat exchange in grey- Non grey bodies- with transmitting- reflecting and absorbing media- Specular surfaces- Gas radiation- radiation from flames.

References:

1. Incropera F.P. and DeWitt D.P., Fundamentals of heat and mass transfer, John Wiley and sons
2. Ozisik M.N., Heat transfer – Basic approach, Mc Graw Hill Co.
3. Eckert E.R.G. and Drake R.M., Analysis of heat and mass transfer, Mc. Graw Hill Co.
4. Bejan A., Convection heat transfer, John Wiley and sons.
5. R.Siegel and JR Howell, Thermal radiation heat transfer, Hemisphere Publishers Co., Washington.

TE-1.5: BOILING AND TWO PHASE FLOW HEAT TRANSFER

(ELECTIVE-I)

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

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 for 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.

References:

1. Two-phase flow and heat transfer by Butterworth and Hewitt, Oxford.
2. Boiling heat transfer and two phase flow by L.S. Tong, John Wiley.
3. Liquid- vapor phase change phenomenon by V.P.Carey, Taylor and Francis.
4. Heat transfer by J.P. Holman.
5. One-dimensional two-phase flow by Wallis, McGraw-Hill.
6. Convective boiling and condensation by J.G. Collier, McGraw-Hill.
7. Hand book of heat transfer by Rohsenow et al.
8. Transport processes in boiling and two-phase flow systems by Hsu and Graham, McGraw-Hill.

TE-1.5: ADVANCED OPTIMIZATION TECHNIQUES

(ELECTIVE-I)

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

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.

TE-1.6: ADVANCED FLUID MECHANICS

(Elective-2)

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

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 through 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.

References:

1. Boundary layer theory, Schlichting by McGraw Hill.
2. Foundations of fluid mechanics by Yuan, Prentice Hall.
3. Turbulence, Bradshaw by Springer-Verlag.
4. Fluid Mechanics by A.K.Mohanty, Prentice Hall of India.
5. Fluid Mechanics and Fluid Power Engineering by D.S.Kumar, S.K.Kataria and Sons.
6. Introduction to Fluid Mechanics and Fluid Machines by S.K.Som and G.Biswas, Tata McGraw Hill Publishing Company Limited.
7. A text book of fluid mechanics and hydraulic machines by R.K.Bansal, Laxmi Publications.

TE-1.6: SOLAR ENERGY TECHNOLOGY

(ELECTIVE-II)

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

Solar Energy Technology: Introduction – Solar energy option, specialty and potential – sun – earth – solar radiation-beam and diffuse – measurement-estimation of average solar radiation on horizontal and titled surfaces – problems – applications.

Capturing solar radiation: Physical principle of collection – types – liquid flat plate collectors – construction details – performance analysis – concentrating collection – flat plate collector with plane reflectors – cylindrical parabolic collectors – orientation and tracking – performance analysis.

Power generation: solar central receiver system – heliostats and receiver – heat transport system – solar distributed receiver system – power cycles – working fluids and prime movers

Thermal energy storage: Introduction – need for storage – methods of sensible heat storage using solids and liquids – packed bed storage – latent heat storage – thermo chemical storage solar pond – working principle – construction application and limitations.

Direct energy conversion: Solid state principles- semiconductors-solar cells-performance-modular construction-applications

Other solar devices: stills – air heaters- driers

Economics: Principles of economic analysis – discounted cash flow – solar system – life cycle costs – cost benefit analysis and optimization-cost based analysis of water heatind and photovoltaic applications

References:

1. G.D.Rai" Solar Energy Utilization"Khanna Publishers
2. H.P.Garg & I.Prakash"Solar Energy"-Fundamentals and application –Wiley Interscience
3. D.Y.Goswami.F.Kreith and I.F.Kreider. Principle of Solar Engineering, Taylor and Francis, Philadelphia
4. Kaushik S.C.Tiwari G.N. and Nayak I.K "Thermal control in passive solar buildings"
5. S.P.Sukhatme, Solar Energy-Principles of thermal collection and storage, second edition, Tata McGraw-Hill, New Delhi.

TE- 1.6 : TRIBOLOGY

(ELECTIVE-II)

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

Introduction: Defining Tribology, Tribology in Design - Mechanical design of oil seals and gasket - Tribological design of oil seals and gasket, Tribology in Industry (Maintenance), Defining Lubrication, Basic Modes of Lubrication, Properties of Lubricants, Lubricant Additives, Defining Bearing, Terminology - Sliding contact bearings - Rolling contact bearings, Comparison between Sliding and Rolling Contact Bearings

Friction and Wear: Friction - Laws of friction - Friction classification - Causes of friction, Theories of Dry Friction, Friction Measurement, Stick-Slip Motion and Friction Instabilities, Wear - Wear classification - Wear between solids - Wear between solid and liquid - Factors affecting wear - Measurement of wear., Theories of Wear, Approaches to Friction Control and Wear Prevention, Boundary Lubrication, Bearing Materials and Bearing Construction

Lubrication of Bearings: Mechanics of Fluid Flow - Theory of hydrodynamic lubrication - Mechanism of pressure development in oil film. Two Dimensional Reynolds's Equation and its Limitations. Idealized Bearings, Infinitely Long Plane Fixed Sliders, Infinitely Long Plane Pivoted Sliders, Infinitely Long Journal Bearings, Infinitely Short Journal Bearings, Designing Journal Bearing - Sommerfeld number - Raimondi and Boyd method - Petroff's Solution - Parameters of bearing design - Unit pressure - Temperature rise - Length to diameter ratio - Radial clearance - Minimum oil-film thickness

Hydrostatic Thrust Bearing: Introduction - Flat plate thrust bearing - Tilting pad thrust bearing, Pressure Equation - Flat plate thrust bearing - Tilting pad thrust bearing, Load - Flat plate thrust bearing - Tilting pad thrust bearing, Center of Pressure - Flat plate thrust bearing - Tilting pad thrust bearing, Friction - Flat plate thrust bearing - Tilting pad thrust bearing

Hydrostatic and Squeeze Film Lubrication: Hydrostatic Lubrication - Basic concept - Advantages and limitations - Viscous flow through rectangular slot - Load carrying capacity and flow requirement - Energy losses - Optimum design. Squeeze Film Lubrication - Basic concept - Squeeze action between circular and rectangular plates - Squeeze action under variable and alternating loads, Application to journal bearings, Piston Pin Lubrications

Elasto-Hydrodynamic Lubrication: Principles and Applications, Pressure viscosity term in Reynolds's equation, Hertz's Theory, Ertel-Grubin equation, Lubrication of spheres, Gear teeth bearings, Rolling element bearings.

Gas (Air) Lubricated Bearings: Introduction, Merits, Demerits and Applications, Tilting pad bearings, Magnetic recording discs with flying head, Hydrostatic bearings with air lubrication, Hydrodynamic bearings with air lubrication, Thrust bearings with air lubrication

Tribological Aspects of Rolling Motion: The mechanics of tyre-road interactions, Road grip and rolling resistance, Tribological aspects of wheel on rail contact

Finite Bearings: Hydrostatic bearings, Hydrodynamic bearings, Thrust oil bearings, Porous Bearings, Foil bearings, Heat in bearings

References:

- Tribology in Indertrion- By Sushil Kumar Srivastava
- Introduction to Tribology of Bearings- By B.C. Majumdar ; A.H.Wheeler
- Principles of Tribology – By J. Halling, Macmillan
- Mechanics and Chemistry in Lubrication- By Dorinson and Ludema , Elsevier
- Friction and wear of Materials- By E. Robinowicz, Johan Wiley
- Principles of Lubrication-By A. Cameron, Longmans

TE-1.7: FUELS AND LUBRICANTS LABORATARY

- Determination of calorific values of fossil and alternate fuels: liquid, gaseous, and solid fuels
- Calibration of pressure (vacuum and low and high pressure gauges) gauges and temperature gauges (below and above zero degrees Celsius).
- Determination of kinematics' viscosities of fossil fuels
- Determination of kinematics' viscosities of alternative liquid fuels (Biofuels)
- Determination of viscosities multi-grade lubricants

TE-1.8 : CFD LABORATARY

Periods/week: 3 Pr. Ses. : 50 Exam: Nil
Examination (Practicals): -- Credits: 2

MATLAB programming for problem solving of Fluid Mechanics, Thermal Engineering and Heat Transfer Problems

C programming for problem solving of Fluid Mechanics, Thermal Engineering and Heat Transfer Problems

Solving Thermal Engineering problems using available packages such as T K Solver: ANSYS, CFX, STARCD, MATLAB, FLUENT etc…

SECOND SEMESTER

TE-2.1: THERMAL, NUCLEAR, HYDEL AND OTEC POWER PLANTS

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

Thermal Power Plants: Constructional features and working principle of thermal power plants: steam based and gas based power plants

Nuclear power: Introduction-why nuclear power for developing countries- The role of nuclear power- Radioactivity & Radioactive charge- unit of radioactivity- mass energy equivalence – usefulness of Einstein theory – Types of nuclear reaction – nuclear fission & fusion – Fertile materials & breeding – location of nuclear power plants, general components of nuclear reactors – fuel – moderator – reflector – coolant control rods- shielding-reflector vessel – general problem of reactor operation.

Nuclear reactors: Current generation power reactors: Pressurized water reactors – boiling water reactors- gas cooled reactors – advanced design – advanced boiling water reactors – modular pressurized heavy water reactors – advanced passive reactors – gas turbine modular helium reactors – breeder reactors – commercial design. Comparison of nuclear plants with thermal plants. Nuclear waste disposal.

Hydrology and hydro electric power plants: Rainfall & its measurements – hydrograph – flow duration curve – mass curve & storage – site selection for hydroelectric power plants – environmental aspects of site selection – classification of hydro-electric power plants – storage type hydroelectric plant & its operation – advantage & disadvantages of hydro electric power plant.

Design construction and operation of hydro electric power plants: Reservior – dams – spillway – surge tank – power house & turbine setting arrangement of reaction & impulse turbine – advantages & disadvantages of underground power station – prime movers – Pelton turbine – Francis turbine – Kaplan turbine – specific speed of turbine – draft tubes – Moody draft tube – selection of turbines – governing of water turbines – advantages of hydro power plants.

Ocean thermal energy conversion (OTEC): The concept – history of OTEC development – constructions operational problem – ecological & environmental impacts. Tidal & water power – Tidal power – wave power – geothermal power potential – geothermal power – history of geothermal power – environment & ecologic consideration.

References:

1. Black and Veatch. " Power Plant Engineering" CBS publishers and distributors
2. GD Rai, Non conventional energy sources, Khana publishers
3. Power Plant Engineering – Arora and Domkundwar, Dhanpat Rai
4. Lamarsh U.R. "Introduction to Nuclear Engineering – Second edition" Addison Wesley M.A.

TE-2.2: ENERGY CONSERVATION IN THERMAL SYSTEMS

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

Introduction: Energy Scenario - world and India. Energy Resources Availability in India. Energy consumption pattern. Energy conservation potential in various Industries and commercial establishments. Energy intensive industries - an overview. Energy conservation and energy efficiency – needs and advantages. Energy auditing - types, methodologies, barriers. Role of energy manager – Energy audit questionnaire - energy Conservation Act 2003

Instruments for Energy Auditing: Instrument characteristics – sensitivity, readability, accuracy, precision, hystersis.Error and calibration.Measurement of flow, velocity, pressure, temperature, speed, Lux, power and humidity. Analysis of stack, water quality, power and fuel quality

Thermal Utilities: Operation and Energy Conservation: (i) Boilers (ii) Thermic Fluid Heaters (iii) Furnaces (iv) Waste Heat Recovery Systems (v) Thermal Storage

Thermal Energy Transmission /Protection Systems: Steam traps– refractories – optimum insulation thickness– insulation – piping design

Financial Management: Investment - need, appraisal and criteria, financial analysis techniques - break even analysis- simple pay back period, return on investment, net present value, internal rate of return, cash flows, DSCR, financing options, ESCO concept.

References:

1. Smith, CB Energy Management Principles, Pergamon Press, NewYork, 1981
2. Hamies, Energy Auditing and Conservation; Methods Measurements, Management and Case study, Hemisphere, Washington, 1980
3. Trivedi, PR, Jolka KR, Energy Management, Commonwealth Publication, New Delhi,
4. Write, Larry C, Industrial Energy Management and Utilization, Hemisphere Publishers, Washington, 1988
5. Diamant, RME, Total Energy, Pergamon, Oxford, 1970
6. Handbook on Energy Efficiency, TERI, New Delhi, 2001
7. Guide book for National Certification Examination for Energy Managers and Energy Auditors (Could be downloaded from www.energymanagertraining.com)

TE-2.3: ALTERNATIVE FUELS AND ADVANCES IN IC ENGINES

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

Introduction: Emission characteristics of fossil fuels, Limitations of fossil fuels; Lead free gasoline, Low/Ultra-low sulfur diesel, Potential alternate fuels: description, applications, and physico-chemical properties of alternative fuels, Fuel quality standards, Physico-chemical properties of fuels, Application of alternate fuels in SI and CI engines, Merits and de-merits of fossil fuels.

Alternate Liquid and Gaseous Fuels: Alcohol based fuels: Methanol and Ethanol, Di-Ethyl-Ether (DEE) and Di-Methyl-Ether (DME); Synthetic diesel: Fischer-Tropsch diesel (FTD), Compressed natural gas (CNG), Liquefied petroleum gas (LPG), Liquefied natural gas (LNG), Hydrogen (H_2); safety precautions, handling/transportation issues, and environmental impact of fuels, Fuel Cells: constructional features and working principle, Merits and de-merits of alternate fuels.

Second and Third Generation Bio-Fuels: Vegetable oils (forest based): use and limitations, Physico-chemical properties and emission characteristics, necessity of esterification and transesterification; Biodiesel (Ethyl and Methyl Esters) produced from vegetable oil feed stocks: Jatropha curcas, Pongamia pinnata/Karanja, Mahua, Palm kernel, Cotton seed, and Micro-Algae; animal feed stocks: Tallow; Processing and Storage methods, National and International Bio-fuel standards: Indian, ASTM (D-6751), European (EN-14214), Japan, and Germany standards.

Engine Electronics: Types and principles of engine sensors: measurement of thermo-physical properties: Air flow, pressure, temperature, oxygen, rpm, torque/load, detonation, position/timing of dead centers and fuel injection systems, electronic ignition, Electronic control module (ECM), Engine management systems, Fuel management systems, digital control techniques, and open & closed loop systems

Modern Engine Technologies: Constructional features and working principle of: DI and IDI engines; Technologies for BS III and IV norms: tuned manifolds, cam-less valve gearing, variable valve actuation/timing(VVT), multi-valve engines, gasoline direct injection (GDI) engines: TBI and MPFI engines; fuel injection strategies, high pressure diesel injection: Common rail direct injection (CRDI-up to 2000 bar) engines, variable compression ratio (VCR) engines, Variable geometry turbo charging (VGT), Variable geometry intercoolers, glow plug, EGR (exhaust gas recirculation) system, HCCI (homogeneous charge compression ignition) engines, Dual-Fuel Technology: CNG-Gasoline, Hydrogen-Diesel, and Alcohols-Diesel, advantages and disadvantages; and race car engines.

Reference Books:

- Automotive Fuels Guide Book , Richard L Bechtold, SAE Publications, 1997
- Present and Future Automotive Fuels, Osamu Hirao and Richard K Pefley, John Wiley and sons ,1988
- Advancements in Electric and Hybrid Electric Vehicle Technology, SP-1023, SAE Inc, 1998
- Advanced Engine Technology, Heinz Heisler, SAE Publications, 1995
- Automobile Electrical and Electronic Systems, by Tom Denton, SAE International, USA, 2000
- Hybrid and Alternative Fuel Vehicles by James D Halderman, 2nd Edition, ISBN: 9780135103845
- Advanced Power Plant Concepts, by SAE Inc, SP-1325, 1998
- Diesel Engine Reference Book, Bernard Challen and Rodica Baranescu, 2/e, R-183, SAE International, 1999
- Internal Combustion Engines by V Ganesan, 2/e, Tata Mc Graw-Hill, ISBN:0-07-049457-6
- Internal Combustion Engines and Air Pollution, by Edward .F. Obert
- Internal Combustion Engine Fundamentals, by John B Heywood, Mc Graw-Hill International Editions, Automotive Technology services, 1988

TE-2.4: DESIGN OF THERMAL EQUIPMENT

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

Classification of Thermal Equipment – Applications; Heat exchangers – a classification; 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

References:

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

TE 2.5: IC ENGINE COMBUSTION AND AIR-POLLUTION

(ELECTIVE-3)

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

Fuels Chemistry and Combustion Principles: Basic principles of combustion: heat of combustion, concepts of combustion, chemical reactions, Stoichiometry, and CHNO analysis, air requirements, Theories of combustion, theoretical flame temperature/adiabatic flame temperature, pre-flame reactions, laminar and turbulent flame propagation in engines, chemical equilibrium and dissociation

Combustion in IC Engines: Combustion in SI engines: Ignition, flame velocity, Normal and abnormal combustion, knocking, pre-ignition, effect of engine variables on knocking, features and design consideration of combustion chambers, concept of lean burn engines, Combustion in CI engines: Air motion: Swirl and squish, spray formation and vaporization, Stages of combustion, physical and chemical delay, diesel knock, effect of engine variables on diesel knock, combustion chambers: design features, Combustion characteristics of Biodiesel and Biodiesel blends, Low NOx diesel combustion: homogeneous charge compression ignition engine (HCCI- combustion), pHCCI, and EGR techniques

Combustion Models: Fuel spray: Factors influencing fuel spray atomization, Spray equation models, penetration and dispersion of fuel, fuel line hydraulics, fuel pumps and injectors, Zero dimensional modeling, quasi dimensional modeling, combustion systems: efficiency and its applications, Single zone models, multi zone models, Premixed and diffusive models, Heat transfer coefficients, and specific heat relations, Weibes function analysis, two zone models, heat transfer in IC engines, heat transfer correlations, data logging and acquisition, cylinder-pressure measurement and Gross and net release rate calculations.

Engine Emissions and Air-Pollution: Emissions and its Formation**:** Gaseous emissions: CO, CO_2, HC, NOx (NO & NO_2), SOx (SO_2 & SO_3); particulate matter (PM), Sources of emission formation; Emissions formation mechanisms of PM and NOx; volatile organic compounds (VOCs), poly aromatic hydrocarbons (PAH), soluble organic fraction (SOF); Mechanism of air pollution: Ozone depletion, Greenhouse effect, Photochemical smog, acid rain, Effect of air-pollution on health and environment, Emission norms (passenger and commercial vehicles): National and International emission standards: BS-III and BS-IV & Euro III, IV, and V

Emission Control Technologies and Emission Measurements: PM reduction technologies: Diesel oxidation catalysts (DOCs), Diesel particulate filters (DPFs), closed crankcase ventilation (CCV); NOx reduction technologies: Exhaust gas recirculation (EGR), Selective catalytic reduction (SCR), Lean NOx catalysts (LNCs), Lean NOx traps (LNTs), NOx adsorber catalysts, Exhaust gas recirculation (EGR), Diesel exhaust after treatment: diesel oxidation catalyst (DOC),

diesel particulate filter (DPF), Soot suppression by fuel additives, relationship: soot, combustion chamber and swirl ratio, catalytic convertors: constructional features and types: 2-way and 3-way catalytic convertors. Measurement of gaseous emissions using thermal, chemical, magnetic and optical gas analyzers: infrared gas analyzer, chemiluminescent analyzer, gas chromatography, smoke (soot) measurement, application of microprocessor in emission control. Trends of emission reduction

Reference Books:

- Combustion Modeling in Reciprocating Engines, by James N Mattavi and Charles A Amann, Plenum press, 1980
- Thermodynamic Analysis of Combustion Engines, by Ashley S Campbell, John Wiley and Sons, 1980
- Internal Combustion Engines and Air Pollution, by Edward .F Obert, Intext Education Publishers, 1980
- Automotive Emission Control , Crouse William, Gregg division, McGraw-Hill,
- Internal Combustion Engine Fundamentals, John B. Heywood, Tata McGraw-Hill,1998
- Internal combustion engine modeling, by J I Ramos, Hemisphere Publishing Corporation, 1989
- Experimental Methods for Engineers by Holman J. P, McGraw-Hill,1988
- Computer Simulation of Spark Ignition Engine Processes, by Ganesan V., University press, 1995

TE- 2.5: MECHATRONICS

(ELECTIVE-3)

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

Electrical Systems: Mathematical modeling of Electro Mechanical Systems, RLC Circuits, active and passive electrical circuits, PMDC Motor, Stepper motor, three phase squirrel cage induction motor, three phase permanent magnet synchronous motor, servo motor.

Mechanical Systems: Introduction to various systems of units, mathematical modeling of mechanical systems, Newton's laws, moment of inertia, forced response and natural response, rotational systems, spring mass system, free vibration, spring mass damper system, mechanical systems with dry friction, work energy and power, passive elements and active elements an energy method for deriving equations of motion, energy and power transformers.

Fluid and Thermal systems: Mathematical modeling of liquid level system: Resistance and capacitance of liquid level systems with interaction. Mathematical modeling of pneumatic systems: Resistance and capacitance of pneumatic systems, mathematical modeling of a pneumatic systems, liberalization of non-linear systems. Mathematical modeling of hydraulic systems: Hydraulic circuits, hydraulic servo-meter and mathematical model of hydraulic servomotor dashpots. Mathematical modeling of thermal systems: Thermal resistance and thermal capacitance mathematical modeling of thermal systems.

Design of Mechanical Elements: The phases of design, Design considerations, codes and standards, optimum design process, design variables, cost functions, design constraints, optimum design. Springs, rolling contact bearing, journal bearing, Spur and helical gear, bevel and worm gears, shafts, axes and spindles, Flexible Mechanical Elements, Belts, timing belts, chain and sprocket, flexible shafts, brakes, clutches, cams, four bar mechanism.

Design of Hydraulic System: Hydraulic circuit design, Actuator design, selection of pumps, selection of valves, design of control circuits.

References:

1. Mechatronics-Electronic Control Systems in Mechanical and Electrical Engineering (2/e)- Boltan, 2nd Edition, Addison Wesley Longman Ltd., 1999
2. Mechatronics System Design-Devdas Shetty, Richard A.Kolk, PWS Publishing Company, 1997 Devdas Shetty, Richard A.Kolk, "Mechatronics System Design", PWS Publishing company 1997
3. Mechatronics: Electronics in products and processes-Bradley D.Dawson, N.C.Burd and A.J.Loader, Chapman and Hall, London 1991.
4. Automated Manufacturing Systems- Actuators, Controls Sensors and Robotics, Brian MorrissMcGraw Hill International Edition 1995.
5. "Mechatronics- Electronic Vontrol Systems in Mechanical and Electrical Engineering", (2/e), Boltan, Addison Wesley Longman Ltd., 1999

TE 2.6 ENERGY MANAGEMENT
(ELECTIVE-4)

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

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
4. Industrial Energy Management and Utilization/L.C. Witte, P.S. Schmidt, D.R. Brown/ Hemisphere Publication/Washingt

TE-2.6: REFRIGERATION AND AIR CONDITIONING

(ELECTIVE-4)

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

Refrigeration Cycles and Analysis: Development of Vapor Compression Refrigeration Cycle from Reverse Carnot Cycle- conditions for high COP-deviations from ideal vapor compression cycle, Multi-pressure Systems, Cascade Systems-Analysis.

Main System Components: Compressor- Types, performance, Characteristics of Reciprocating Compressors, Capacity Control, Types of Evaporators & Condensers and their functional aspects, Expansion Devices and their Behavior with fluctuating load.
Refrigerants: Classification of Refrigerants, Refrigerant properties, Oil Compatibility, Environmental Impact-Montreal / Kyoto protocols-Eco Friendly Refrigerants. Different Types of Refrigeration Tools , Evacuation and Charging Unit , Recovery and Recycling Unit , Vacuum Pumps.

Systems Balance and Controls: Estimation of Cooling Load, System Equilibrium and Cycling Controls, Electric Circuits in- Refrigerators, Window A/C, Types of motors, Relays.
Other Refrigeration Cycles: Vapor Absorption Systems-Aqua Ammonia & LiBr Systems, Steam Jet Refrigeration Thermo Electric Refrigeration, Air Refrigeration cycles.

Summer and Winter Air Conditioning: Air conditioning processes-RSHF, summer Air conditioning, Winter Air conditioning Bypass Factor. Applications with specified ventilation air quantity- Use of ERSHF, Application with low latent heat loads and high latent heat loads.
Load Estimation and Air Conditioning Controls: Solar Radiation-Heat Gain through Glasses, Heat Transfer through Walls and Roofs-Total cooling load estimation. Controls of temperature, Humidity, and Airflow

References:

1. Principles of refrigeration- Dossat R.J., John Wiley, S.I. Version (2001).
2. Refrigeration and Air conditioning-Stoecker W.F., McGraw-Hill Book, Company, 1989
3. Refrigeration and Air conditioning- Jordan and Priester, 1985.

4. Principles and Refrigeration- Goshnay W.B., Cambridge, University Press, 1985.
5. Solid state electronic controls for HVACR' -Langley, Billy C., 'Prentice-Hall 1986
6. Refrigeration and Air Conditioning- Arora C.P., Tata McGraw Hill Pub. Company
7. Handbook of Air Conditioning Systems design- Carrier Air Conditioning Co., McGraw Hill,
8. Refrigeration and Air Conditioning (3/e) - Langley Billy C., Engie wood Cliffs (N.J) PHI.
9. Fundamentals and equipment- 4 volumes-ASHRAE Inc. 2005.
10. Air Conditioning Engineering-Jones, Edward Amold pub. 2001.

TE- 2.6: THERMAL MANAGEMENT OF ELECTRONIC EQUIPMENT

(ELECTIVE-4)

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

Modes of heat transfer, Heat transfer coefficient.

Power transistors, Power diodes, Central processing units (CPUs)

Causes of heat generation in electronic systems, Effects of excessive joint temperature, Need for cooling of electronic components. Thermal cooling options: air and liquid, Newton's law of cooling, Trends in selection of cooling media and arrangements.

Application of extended surfaces: external fins, heat sinks, Trends in heat sink technology, Forced draught, Fan sizing procedure and fan selection guidelines, Fans working in series and in parallel.

Heat transfer compounds, Thermally conductive pastes, Epoxy resins, Liquid cooling of electronic devices, Liquid coolants and alternative liquid coolants for high density electronics,

Heat pipes, Technical characteristics of heat pipes, Micro channel, and two-phase cooling, Cooling methods with phase change: Evaporation and Condensation.

Thermoelectric cooling: Thermoelectric cooling principles (TEC), Applications in electronics systems, Peltier effect of cooling and semi conductors, Cooling of automotive electronics, Specification of power dissipation, Trends in thermal management.

Reference Books:

- Fluid Flow, Heat Transfer and Boiling in Micro-Channels by L.P. Yarin, A. Mosyak and G. Hetsroni, 2009 Springer-Verlag Berlin Heidelberg ISBN 978-3-540-78754-9 and e-ISBN 978-3-540-78755-6

- The CRC Handbook of Thermal Engineering, by Frank Kreith Springer, ISBN: 3-540-66349-5

TE-2.7: I.C. ENGINES AND GAS TURBINE LABORATORY

Periods/week: 3 Pr. Ses. : 50 Exam: 50
Examination (Practical's): --- Credits: 3

- Determination of Performance Characteristics of Single cylinder (stationery) Petrol Engines
- Determination of Performance Characteristics of Single cylinder (stationery) Diesel Engines
- Determination of Sankey diagram for variable speed/load engines
- Determination of Morse Test on MPFI Engine
- Determination of Performance Characteristics (Power/Torque) of Automotive Engines

TE-2.8: I.C. ENGINE COMBUSTION AND EMISSIONS LABORATORY

Periods/week: 3 Pr. Ses. : 50 Exam: 50
Examination (Practical's): --- Credits: 3

List of Experiments:

- Measurement of injection pressure and cylinder pressure of stationery and automotive Engines.
- Determination of net and cumulative (gross) heat release rates of an IC engines (Gasoline, Diesel and VCR Engines) from cylinder pressure.
- Determination of mass fraction (fuel) burned during combustion in IC engines (Gasoline, Diesel and VCR Engines)

- Measurement of smoke (soot) emissions of Gasoline, Diesel and Bio-Fuel Engines
- Measurement of Gaseous emissions (HC, CO, CO_2, NOx, SOx, and O_2) of Gasoline, Diesel and Bio-Fuel Engines

THIRD SEMESTER & FOURTH SEMESTER

Student has to complete ONE YEAR PROJECT (TE-301 E), in the areas of thermal engineering. The research areas are mainly the currents trends in mechanical engineering in particular thermal engineering related subjects (core or electives).

The standard of the thesis must be Masters Degree Level and he/she should publish/communicate their research work to any referred journal/conference of national or international level.