`

KANNUR UNIVERSITY

Faculty of Engineering

Curriculum, scheme of Examination and Syllabi for M.Tech degree

Programme with Effect from academic year 2012-2013

M.TECH IN MECHANICAL ENGINEERING

(THERMAL AND FLUIDS ENGINEERING)

Kannur University

FIRST SEMESTER

Code	Subject	Hours/week			Sessional Marks	University Examination		Credit
		L	T	P		Hrs	Marks	
MTF 101	Advanced Engineering Mathematics	3			50	3	100	3
MTF 102	Advanced Engineering Fluid Dynamics	3			50	3	100	3
MTF 103	Advanced Heat Transfer	3			50	3	100	3
MTF 104	Postulational Thermodynamics	3			50	3	100	3
MTF 105	Elective I	3			50	3	100	3
MTF 106	Elective II	3			50	3	100	3
MTF 107(P)	Laboratory –Thermal Science Laboratory			2	50	3	100	2
MTF 108(P)	Seminar			2	50			2
TOTAL		18		4	400		700	22

ELECTIVE I

MTF 105 (A) Thermal Environmental Engineering
MTF 105 (B) Energy Conservation & Heat Recovery Systems
MTF105(C) Advanced Gas Dynamics
MTF105 (D) Bio-Fluid Dynamics
MTF105 (E) Combustion Science

ELECTIVE II

MTF 106 (A) Refrigeration Engineering
MTF 106 (B) Convection and Two Phase Flow
MTF 106 (C) Finite Element Methods in Engineering
MTF106 (D) Hydraulic, Pneumatic and Fluidic Controls
MTF106 (E) Solar Thermal Engineering

Kannur University

SECOND SEMESTER

Code	Subject	Hours/week			Sessional Marks	Unversity Examination		Credit
		L	T	P		Hrs	Marks	
MTF 201	Computational Methods in Fluid flow and Heat transfer	3			50	3	100	3
MTF 202	Principles of turbo machines	3			50	3	100	3
MTF 203	Measurements in Thermal Engineering	3			50	3	100	3
MTF 204	Elective III	3			50	3	100	3
MTF 205	Elective IV	3			50	3	100	3
MTF 206	Elective V	3			50	3	100	3
MTF 207(P)	Laboratory – Computational Lab			2	50	3	100	2
MTF 108(P)	Term Paper			2	50	3	100	2
TOTAL		18		4	400		700	22

ELECTIVE III

MTF 204 (A) IC Engines Systems, Combustion and Performance Analysis
MTF 204 (B) Renewable Energy Technology
MTF 204 (C) Fuels and Combustion.
MTF 204 (D) Design and Optimization of Energy Systems
MTF 204 (E) Transport Phenomena

ELECTIVE IV

MTF 205 (A) Design of Heat Transfer Equipment
MTF 205 (B) Fire Dynamics
MTF 205 (C) Optimisation Techniques
MTF 205 (D) Gas Turbines and Jet Propulsion
MTF 205 (E) Air-conditioning System Design

ELECTIVE V

MTF 206 (A) Aerodynamics
MTF 206 (B) Boundary Layer Theory
MTF 206 (C) Introduction to Turbulence
MTF 206 (D) Robust Design
MTF 206 (E) Nuclear Engineering

Kannur University

THIRD SEMESTER

Code	Subject	Hours/week			Marks					Credit
		L	T	P	Internal		University		Total	
					Guide	Evaluation Committee	Thesis	Viva		
MTF 301 (P)	Thesis Preliminary			22	200	200			400	8
TOTAL				22	200	200			400	8

FOURTH SEMESTER

Code	Subject	Hours/week			Marks					Credit
		L	T	P	Internal		University		Total	
					Guide	Evaluation Committee	Thesis	Viva		
MTF 401 (P)	Thesis			22	200	200	100	100	600	12
TOTAL				22	200	200	100	100	600	12

Assessment in Theory Subjects

The maximum marks allotted for internal continuous assessment and end-semester university examinations shall be 50 marks and 100 marks respectively with a total of 150 marks.
The weightage to award internal assessment marks should be as follows:
Test papers (minimum two): 50%
Assignments of any suitable mode: 50%
The following will be the weightages for the different examinations of theory based Subjects.
Internal continuous assessment: 50%
End Semester Examination: 100%

Assessment in Practical Subjects

Internal continuous assessment and end-semester practical examinations will have 1:2 weightage for practical subjects, with 50 marks allotted for internal continuous assessment and 100 marks for end semester examinations.
Internal continuous assessment: 50%
End Semester Examination: 100%
The weightage to award internal assessment marks should be as follows:
Laboratory class work and records : 70%
Test : 30%
University shall appoint two examiners (Internal and external examiners) for each practical subject in order to conduct end-semester University examinations. Award of marks in the end-semester practical examinations (except Project) should be as
follows:
Fair record – 10%
Viva voce – 20%
Procedure and tabulation format,
Conducting experiment, results and inference – 70%
No candidate will be permitted to attend the end-semester practical examinations unless he/she produces certified record of the laboratory.

Assessment of Seminar/Thesis Work

The seminar, project and Industrial training will be evaluated by the Evaluation committee. The students are required to submit a report of the work done/training undergone and present the contents of the report before the committee which will be evaluated. The internal evaluation of the seminar in first semester and term project/mini project in the second semester would be done by the department Evaluation committee. In the third semester, Masters Research Project Phase I also will be evaluated by the Department Evaluation committee. Final University evaluation of the fourth semester project and dissertation would be conducted by the Guide and an External Examiner appointed by the Kannur University.

Kannur University

MTF 101/MTE 101 ADVANCED ENGINEERING MATHEMATICS

3 hours lecture per week

References: Fourier Transform methods – one-dimensional heat conduction problems in infinite and semi-infinite rod – Laplace Equation – Poisson Equation. Concept of variation and its properties – Euler's equation – Functionals dependant on first and higher order derivatives – Functionals dependant on functions of several independent variables – Variational problems with moving boundaries – Direct methods – Ritz and Kantorovich methods.

The Schwarz- Christoffel Transformation – Transformation of Boundaries in Parametric Form – Physical Applications: Fluid Flow And Heat Flow Problems**.**

First order PDEs, Linear equations, Lagrange method, Cauchy method, Charpits method, Jacobi method. Second order PDEs, Classifications, Formulation and method of solutions of Wave equation, Heat equation and Laplace equation.

One dimensional parabolic equation – Explicit and Crank-Nicolson Schemes – Thomas Algorithm – Weighted average approximation – Dirichlet and Neumann conditions – Two dimensional parabolic equations – ADI method.

Solutions of Laplace and Poisson equations in a rectangular region – Finite difference in polar coordinates – Formulae for derivatives near a curved boundary while using a square mesh.

References

1. Mitchell A.R. and Griffith D.F., The Finite difference method in partial differential equations, John Wiley and sons, New York (1980)
2. Gupta, A.S., Calculus of Variations with Applications, Prentice Hall of India Pvt. Ltd., New Delhi (1997).
3. Introdrocution to PDE – K. Sankara Rao – Prentice hall of India.
4. Advanced Engg. Mathematics – Erwin Kreyzig
5. Partial Differential Equations-Sneddon
6. Introductory methods of numerical analysis – S.S. Sastry – Prentice hall of India.
7. Tychonov, A. N. and Samarskii, A. A., Partial Differntial Equations of Mathematical Physics, Holden-Day, 1964.
8. Pipes, L. A. and Harwill, L. R., Applied Mathematics for Engineers and Physicists,Third Edition, McGraw-Hill, 1970.
9. Ross, S. L., Differential Equations, Third Edition, John Wiley & Sons, 2004.

Question Pattern:

There would be seven questions out of which five should be answered. Each question would carry twenty marks each. Each question shall carry a minimum of two and a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus

Kannur University

MTF 102 ADVANCED ENGINEERING FLUID DYNAMICS

3 hours lecture per week

Review of fundamental concepts – continuum, control volume, Eulerian and Lagrangian methods of description of fluid flow; Reynolds transport equation – integral and differential forms of continuity, momentum, and energy equations, Navier-Stokes equations and boundary conditions; Non-dimensionalization of equations and order of magnitude analysis, dimensionless parameters and their significance; classification of flows based on the characteristic Reynolds number; equations for low and high Reynolds number flows.

Exact solutions of incompressible Navier-Stokes equations – Couette flow, flow between rotating cylinders, Stokes problems, stagnation point flow, flow near a rotating disk, fully developed flow through ducts; Low Reynolds number flows, use of vorticity and stream function, creeping flow past a sphere, hydrodynamic theory of lubrication.

Boundary layer theory, D' Alemberts paradox, Prandtl's boundary layer equations, Blasius solution and other similarity solutions of the laminar boundary layer, flow in wakes and jets, Karman's momentum integral equations, prediction of boundary layer separations.

Introduction to turbulent flow, stability of laminar flow, mean motion and fluctuation, time averaged turbulent flow equations, Reynolds stresses, boundary layer equations, boundary conditions, eddy viscosity, mixing length hypothesis, similarity hypothesis, universal velocity distribution laws, flow through pipes and ducts, turbulent jets and wakes.

References:

1. White, F. M., Viscous Fluid Flow, Third Edition, McGraw-Hill, 2006
2. Schlitching, H., Boundary Layer Theory, Seventh Edition, McGraw-Hill, 1987.
3. Papanastasiou, T. C., Georgiou, G. C., and Alexandrou, A. N., Viscous Fluid Flow, CRC Press, 2000.
4. Muralidhar, K. and Biswas, G., Advanced Engineering Fluid Mechanics, Second Edition, Narosa Publishing House, 2005.
5. Schetz, J. A., Boundary Layer Analysis, Prentice Hall,1994.
6. Foundations of Fluid Mechanics- Yuan S W
7. Fluid Mechanics and its Applications- Gupta & Gupta
8. Introduction to Fluid mechanics- Fox & Mcdonald

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MTF 103/MTE 102 ADVANCED HEAT TRANSFER

3 hours lecture per week

Conduction: Differential formulation of steady one-dimensional heat conduction problems and their analytical solution – heat transfer characteristics of straight, annular, and pin fins of uniform and non-uniform cross sections. Steady state conduction with uniform internal heat generation-temperature distribution and heat flux for regular solids with uniform heat generation-temperature dependent and location dependent heat generation-steady state conduction in two dimensional systems. Analytical, graphical analog and numerical methods. Unsteady state conduction: unsteady state heating or cooling-Newtonian heating or cooling- Heating or cooling of finite and semi-infinite slabs with negligible surface resistance for different boundary conditions-solutions of heating or cooling of regular solids with comparable internal and external resistance by simple analytical methods and use of charts-periodic variation of surface temperature of infinitely thick walls neglecting and considering surface resistances.

Convection: Forced convection: Equations of motion of a viscous fluid. General equation of energy transport - 2D boundary layer equation for momentum and energy transport. Laminar flow heat transfer: Exact solutions of the 2D boundary layer momentum and energy equations. Approximate calculations of the boundary layer by the momentum and energy integral equations. Turbulent flow heat transfer: Time averaged equations of continuity, momentum and energy. Analog methods- Reynolds, Prandtl and von Karman.Free convection: Solutions of the boundary layer equations for a vertical plate and a horizontal cylinder – approximate solutions-free convection with a turbulent boundary layer- free convection in enclosed spaces.

Radiation: Radiative properties of real materials Radiative properties of metals and opaque non-metals-modifications of spectral characteristics. Exchange of radiant energy between black isothermal surfaces. Radiative exchange between two surfaces- methods for evaluating configuration factors –radiation in a black enclosure, Radiation exchange in an enclosure composed of diffuse-gray surfaces Radiation between finite areas-radiation between infinitesimal areas, Solar and gas radiation.

References:

1. Glen E. Myers, Analytical Methods in Conduction Heat Transfer, McGraw-Hill, 1971.
2. Yunus A Cengel, Heat and Mass Transfer, A practical approach, Tata McGraw-Hill, 2007.
3. Holman, J. P., Heat Transfer, Ninth Edition, Tata McGraw-Hill, 2002.
4. D. Poulikakos: Conduction Heat Transfer, Prentice Hall, 1994.
5. Fundamentals of Heat and Mass Transfer- Incropera F P and Dewitt D P
6. V.S. Arpaci: Conduction Heat Transfer, Addision Wesly, 1996
7. H.S. Carslaw and J.C. Jaeger: Conduction of Heat in Solids, Oxford University Press, 1959.
8. Bejan: Convection Heat Transfer, J. Wiley, 2007
9. M.F. Modest: Radiative Heat Transfer, McGraw Hill, 1993
10. Siegel and Howell, Thermal radiation Heat transfer, McGraw Hill,
11. Kays and Crawfard., Convective heat and mass transfer, Mc-Graw Hil

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MTF 104/MTE 103 POSTULATIONAL THERMODYNAMICS

3 hours lecture per week

Review of the fundamentals of classical thermodynamics- First law applied to unsteady flow systems. Thermodynamic functions and property relations. Irreversible thermodynamics – coupled and uncoupled effects-examples.

Second law analysis of steady and unsteady flow systems. Entropy. Availabilty. Loss of Available energy. Exergy analysis. Vapour and Combined Power cycles. Properties of Gas mixtures. Second law of thermodynamics and concept of chemical equilibrium, Gibbs free energy and the equilibrium constant of a chemical reaction (Vant Hofts equation). Calculation of equilibrium composition of a chemical reaction.

Thermodynamics of Combustion. Equations of combustion – stoichiometry. Analysis by mass, volume and their conversion. Mole method for combustion problems. First and second law analysis of reacting systems. Introduction to thermochemistry – Heat of reaction and it's effect on temperature and pressure. Enthalpy of formation and types of heat changes.

Microscopic approach to thermodynamics. Kinetic theory of gases- equipartition of energy - Molecular flux - Survival equation- Application to Transport Phenomena – Viscosity, Thermal conductivity and diffusion.

Fundamentals of Statistical Thermodynamics - Micro and Macro States - Thermodynamic Probability. Partition Function and evaluation of thermodynamic properties –- Statistical interpretation of heat, work and entropy.

References:

1. Statistical Thermodynamics – Kellen
2. Thermodynamics – Michael A Saad
3. Thermodynamics, KineticTheory and Statistical
4. Thermodynamics –F.W. Sears & G. L. Salinger.
5. Kuo, K.K., Principles of combustion, Wiley Inter science , New york,1986.
6. Murthy,K.A., Introduction to combustion, Golden and Breach, New York, 1975.
7. Sharma, S.P and Chandra Mohan, Fuels and combustion, McGraw Hill, 1984.

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MTF 105(A) THERMAL ENVIRONMENTAL ENGINEERING

3 hours lecture per week

Thermal comfort, effective temperature, comfort chart – inside design condition, ventilation standards, applied psychrometry, summer air conditioning processes, winter air conditioning processes.

Estimation of air conditioning loads - heating and cooling; heat gain/loss through glass, heat gain/loss through structures, internal load, ventilation load, and infiltration load.

Air distribution: room air distribution, air diffusion equipments, friction losses and dynamic loss in ducts, air dust design; Air handling equipments: Fans – types, performance, and selection; air conditioning apparatus, cooling dehumidifying, humidifying heating and cleaning equipments.

Air conditioning systems, DX system, all water system, all air system, air water system, central and unitary systems, fan coil system; automatic controls of air conditioning systems, thermostats, dampers, and damper motors; automatic valves piping design- water piping, refrigerant piping, stem piping.

References:

1. Threlkeld, J. L., Thermal Environmental Engineering, Second Edition, Prentice Hall, 1970.
2. Norman C. Harris, N. C., Modern Air Conditioning Practice, Third edition, McGraw-Hill, 1985.
3. Levenhagen, J. L., Spethmann, D. H., Heating Ventilating and Air conditioning Controls and Systems, McGraw Hill1993.

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MTF 105 (B)/MTE 105 (A) ENERGY CONSERVATION & HEAT RECOVERY SYSTEMS

3 hours lecture per week

Energy consumption and potential for energy conservation in industry-thermodynamics of energy conservation-energy flows-energy auditing-technologies for energy conservation-thermal insulation. waste heat recovery systems, thermal energy storage, heat exchanger, heat pumps, heat pipes, waste heat to mechanical energy conversion systems. design for conversion of energy, simulation and modelling. Applications and case studies.

Definition of energy management - Energy conservation schemes - Optimizing steam usage - Waste heat management - Insulation - Optimum selection of pipe size – Energy conservation in space conditioning – Energy and cost indices - Energy diagrams – Energy auditing - Thermodynamic availability analysis – Thermodynamic efficiencies - Available energy and fuel.

Thermodynamic analysis of common unit operations - Heat exchange - Expansion - Pressure let down - Mixing- Distillation - Combustion air pre-heating – Systematic design methods - Process synthesis - Application to cogeneration system – Thermo-economics - Systematic optimization - Improving process operations – Chemical reactions - Separation - Heat transfer - Process machinery - System interaction and economics

Potential for waste heat recovery - Direct utilization of waste heat boilers – Use of heat pumps – Improving boiler efficiency - Industrial boiler inventory – Use of fluidized beds - Potential for energy conservation – Power economics - General economic problems - Load curves - Selections of plants - Specific economic energy problems - Energy rates.

References:

1. Kenney W F- Energy conservation in the Process industries
2. Chiogioji M H- Industrial energy conservation
3. Bernhardt G A. Sjritsju & Vopat W A – Power station engineering & economy
4. Thumann, Albert PE- Plant Engineers and Managers Guide Energy Conservation
5. Dubin F B-Energy conservation standards
6. A.P.E. Thummann: Fundamentals of Energy Engineering, Prentice Hall, 1984
7. M.H. Chiogioji: Industrial Energy Conservation, Marcel Dekker, 1979
8. W. R. Murphy and G. McKay: Energy Management, Butterworth-Heinemann, 2001

Question Pattern:

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MTF 105 (C) ADVANCED GAS DYNAMICS

3 hours lecture per week

Normal Shocks: Governing equations, Rankine Huguenot, Prandtl and other relations, weak shocks, thickness of shocks, normal shocks in ducts, performance of convergentdivergent nozzle with shocks, moving shock waves, shock problems in one dimensional supersonic diffuser, supersonic pitot tube.

Flow in Constant Area Duct with Friction: Governing equations, working formulas and tables, choking due to friction, performance of long ducts, Isothermal flow in long ducts.

Flow in Constant Area Duct with Heating and Cooling: Governing equations, working formula and tables, choice of end states, choking effects, shock waves with changes in stagnation temperature.

Generalized One-Dimensional Flow: Working equations, general method of solution, example of combined friction and area change, Example of combined friction and heat transfer.

Oblique shock: governing physical equations and general relations, shock polar diagram and auxiliary diagrams, strong and weak shocks, detached shock, interaction and reflection of shocks.

Method of characteristics: general principle of integration using method of characteristics, application to one dimensional isentropic progressive waves, application to steady two dimensional irrotational isentropic supersonic flows, Prandtl-Meyer expansion.

Boundary layer flow with Prandtl number unity and arbitrary Prandtl number, Integral equations of Laminar boundary layer, Differential and integral equations of Boundary layer, flow past a flat plate with turbulent Prandtl number of Unity. Elementary idea of boundary layer in tubes and in the presence of shock waves. Study of various flow visualization techniques. Study of different types of wind tunnels, their design criteria.

References:

1. E. Rathakrishnan, Gas Dynamics , Prentice-Hall of India, New Delhi, 2002.
2. M.A. Saad, Compressible Fluid Flow , Prentice-Hall, New Jersey, 1985.
3. A. H. Shapiro, The Dynamics and Thermodynamics of Compressible Fluid Flow (2 volumes), The Ronald Press, New York, 1953.
4. Pope, Wind Tunnel Design.

Question Pattern:

There would be seven questions out of which five should be answered. Each question would carry twenty marks each. Each question shall carry a minimum of two and a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus.

MTF 105 (D) BIO FLUID DYNAMICS

3 hours lecture per week

Introduction to Fluid Mechanics: Fluid properties, basic laws governing conservation of mass momentum and energy; Laminar flow, Couette flow and Hagen-Poiseuille equation, turbulent flow.

Bio-fluid Dynamics: Blood system network and physiology, blood rheology, Vessel structure and mechanical properties Lymphatic system; Body fluids and their motions; Flow of Newtonian and non-Newtonian fluids in rigid tubes, flexible tubes and collapsible tubes.

Heart and pumping process, Blood flow in body, Flow dynamical study of circulatory system, heart and blood vessels, anatomy and physiological considerations; Components and functions of arterial and venous systems: Blood flow through arteries and veins; Kinetic energy, flow, pressure-flow relations in vascular beds; Cardiac cycle; Cardiac valve dysfunctions; Blood pressure, regulation and controlling factors; Coronary circulation, heart failure.

Engineering Applications: Dialysis, Heart-lung machines. Lung and airways system network and physiology.

References:

1. J.N. Mazumdar, Biofluid Mechanics , World Scientific, 1992.
2. Y.C. Fung, Biomechanics: Motion, Flow, Stress, and Growth , Springer-Verlag, 1990.
3. .M. Berne, M.N. Levy, Cardiovascular Physiology, R 8th Edition, Mosby, 2001.

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MTF 105 (E)/MTE 105 (C) COMBUSTION SCIENCE

3 hours lecture per week

Thermodynamics of reactive mixtures-bond energy, heat of formation, heat of reaction, adiabatic flame temperature- entropy changes for reacting mixtures-chemical equilibrium-equilibrium criteria-evaluation of equilibrium constants and equilibrium composition.

Elements of chemical kinetics-Law of mass action-order and molecularity of reaction-rate equation-Arrhenius Law- activation energy-collision theory of reaction rates –transition state theory-general theory of chain reactions-combustion of CO and hydrogen. Ignition and flammability-methods of ignition-self ignition –thermal theory of ignition-determination of self ignition temperature and experimental results-energy required for ignition-limits of inflammability-factors affecting flammability limits-flame quenching –effects of variables on flame quenching.

Flame propagation-flame velocity-measurement of flame velocity- factors affecting flame speed-premixed and diffusion flames, physical structure and comparison- characteristics of laminar and turbulent flames- theory of laminar flame propagation-empirical equations for laminar and turbulent flame velocities.

Flame stabilization-stability diagrams for open flames- mechanisms of flame stabilization, critical boundary velocity gradient-stabilisation by eddies-bluff body stabilization-effects of variables on stability limits. Gaseous Burner flames. Droplet Combustion. Boundary layer combustion. Combustion of coal –burning of pulverised coal-fluidised bed combustion-gasification of coal. Combustion applications-coal burning equipment, oil burners, gas burners, stoves. Free burning fires-flame spread over fuel beds-forest fires-fires in buildings-liquid fuel pool fires-fire suppression and prevention Combustion generated air pollution. Clean combustion systems.

References :

1. Combustion Flame and Explosion of Gases- Lewis and von Elbe
2. Some fundamentals of combustion-D B Spalding
3. Fundamentals of combustion-Strehlow R A
4. Elementary Reaction Kinetics-J L Lathan
5. Flames-Gaydon A G & Wolfhard H G
6. Combustion-Jerzy Chomiak

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Kannur University

MTF 106 (A)/MTE 106 (A) REFRIGERATION ENGINEERING

3 hours lecture per week

Review of thermodynamics of Refrigerants, Properties (packages like REFPROP), different methods of refrigeration, advanced vapour compression systems, multi pressure systems, Flash gas removal, Two evaporator and one compressor systems, one evaporator and two compressor systems, other combinations of compressors, evaporators and condensers, Low temperature refrigeration, cascade systems.

Vapour absorption refrigeration systems, principles of operation, description of components and their constructional features-refrigerant, absorber combinations. Criteria for selection-performance analysis

Energy sources in vapour absorption systems- thermal, solar and electric. Steam jet refrigeration systems, Thermo-electric refrigeration systems- Vortex and pulse tube refrigeration systems, air cycle refrigeration systems.

Environmental impact of Refrigerants - Global warming, Ozone depletion, Alternate refrigerants, future refrigerants

References:

1. Gosuey W.B.: Principles of Refrigeration
2. Stoecker: Principles of Refrigeration
3. Dossat: Principles of Refrigeration
4. Transactions of ASHRAE
5. Throlkeld J L: Thermal Environmental Engineering

Question Pattern:

There would be seven questions out of which five should be answered. Each question would carry twenty marks each. Each question shall carry a minimum of two and a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus.

MTF 106 (B) CONVECTION & TWO PHASE FLOW

3 hours lecture per week

Convection heat transfer Equations: Conservation principles, differential equations of the boundary layer, Momentum, Mass diffusion and energy equations, simplified equations for velocity boundary layer and thermal boundary layer, integral equation of boundary layer, equations for turbulent boundary layer . Turbulent flow over a flat plate and a circular pipe-universal velocity distribution.

Convective heat transfer-Forced convection in laminar flow-flow inside smooth tubes-energy differential equations. Fully developed velocity and temperature profiles. Thermal entry length solutions for circular tubes-effect of axial variations of the surface temperature and heat flux-combined hydrodynamic and thermal entry length, the flat plate in Laminar flow-similarity solution-flow over bodies with boundary layer separation.

Forced convection in Turbulent flow. Analogy between momentum and heat transfer. Reynold's analogy, Karman-Boelte Martinelli analogy- circular tubes with fully developed flow, constant heat rate, modarare Prandtl Numbers. The eddy diffusivity near the centre line of a pipe-Fully developed profiles with constant surface temperature-fully turbulent flow between parallel planes-Thermal entry length in circular tubes-Effect of axial variation of surface temperature and heat flux. Influence of surface roughness- The plane plate in longitudinal flow. Free Convection : Boundary layer equations-vertical semi infinite plate, constant and variable temperature, effect of wall suction and blowing and variable properties. Approximate Integral solutions for free convection, free convection flow regimes, free convection between heated plates, solution for other geometry, combined free and forced convection.

Methods of Analysis-flow patterns- vertical and horizontal channels – flow pattern maps and transitions. Void fraction – definitions of multiphase flow parameters – one dimensional continuity, momentum and energy equation- Pressure gradient components: frictional, acceleration and gravitational. Basic Flow Models : Homogeneous flow model-Pressure gradient-Two phase friction factor for laminar and turbulent flow-two phase viscosity-friction multiplier. Separated flow model-pressure gradient relationship-Lokhart-Martinelli correlation – Parameter X and its evaluation.

Note : Use of approved charts and tables will be permitted in the examinations.

References:

1. H. Schlitching : Boundary Layer Theory
2. W M Kays & M E Crawford : Convective Heat and Mass Transfer
3. Eckert and Drake; Analysis of Heat and Mass Transfer
4. Bejan. A, Convective Heat Transfer.

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MTF 106 (C) FINITE ELEMENT METHODS IN ENGINEERING

3 hours lecture per week

Review of the fundamentals of the three modes of heat transfer. Governing differential equations. Initial and boundary conditions. Review of the numerical techniques for the solution of matrix equations.

Basic concepts of Finite Element method. Mesh generation- Types of elements, Node numbering scheme. Interpolation polynomials. Finite element equations and element characteristic matrices. Variational approach, Galerkin approach. Assembly of element matrices. Solution of finite element system of equations.

Steps involved in a thermal analysis. Analysis of linear and nonlinear conduction problems in steady and transient hea t transfer. 1D, 2D and 3D analysis with simple examples. Axisymmetric heat transfer. Finite element solution in the time domain.

Effects of convection in heat transfer- advection-diffusion. Analysis of heat transfer problems with radiation. Concepts of adaptive heat transfer analysis. Implementation of the adaptive procedure. Computer programming and implementation of FEM. Introduction to general purpose FEM packages.

References:

1. O.C Zienkiewicz, The Finite Element Method, 3rd Edition, Tata McGraw-Hill, 1983.
2. C.S. Desai and J.F. Abel, Introduction to Finite Element Method, Affiliated East-West Press, 1977.
3. R.D. Cook, Concepts and Application of Finite Element Analysis, John Wiley , 2nd Edition,1981.
4. R W Lewis, K Morgan, H R Thomas and K Seetharamu: The Finite Element Method in Heat Transfer Analysis
5. H C Huang and A Usmani: Finite Element Analysis for Heat Transfer
6. Tirupathi, R. .Chandrupatle and Ashoka D. Belegundu, Introduction to Finite Elements in Engineering , PHI.
7. J.N. Reddy, An Introduction to Finite Element Method, McGraw-hill, New York.
8. C.S. Krishnamurthy, Finite Element Analysis -Theory and Programming, Tata McGraw Hill Publication, New Delhi.
9. S.S. Rao, The Finite Element Method in Engineering, Pergamon, New York.

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MTF106 (D)/MTE 106 (E) HYDRAULIC, PNEUMATIC AND FLUIDIC CONTROLS

3 hours lecture per week

Introduction to hydraulic/pneumatic devices, their applications and characteristics-comparison of electric, hydraulic and pneumatic devices. Pumps and motors: principles of working, range of displacement and pressures. Fixed and variable discharge pumps, gear pumps, internal gear pump, serotor pump, vane pump/piston pump, axial piston pump, swash plate pump, bent-axis pump. Types of hydraulic motors and their characteristics. Accessories: Hydraulic accumulators, intensifiers, filters, heater, cooler, tank.

Hydraulic valves: Stop valve, non-return valve, relief valve, sequence valve, counter balance valve, pressure reducing valve, flow control valves, direction control valves, their principles of operations and applications. JIC symbols of hydraulic/pneumatic components. Properties of commonly used hydraulic fluids.

Typical hydraulic circuits: Examples of practical circuits like those used in machine tools, riveter, pneumatic hammer, hydraulic pressure, power steering. Design of hydraulic/pneumatic equipment/circuit to fulfil a given set of requirements like a sequence of operations, load conditions, speed of operation etc. Specifying the components and their rating. Drawing the circuit using standard symbols.

Fluidics: Introduction to fluidic devices, principle of working of common fluidic devices like wall attachment devices, proportional amplifiers, turbulent amplifiers, fluidic logic devices. Examples of applications of fluidic devices like edge control of steel plate in rolling mills, tension control.

References:

1. Pippenger , John J & Koff Richard M: Fluid Power Controls
2. Pippenger , John J & Hicks,Tyler G: Industrial Hydraulics
3. Kirshner, Joseph M: Fluid Amplifiers
4. Kirshner, Joseph M & Silas Katz: Design Theory of Fluidic components
5. Dr. Heinz Zoebl, Techn: Fundamentals of Hydraulic circuitry

Question Pattern:

There would be seven questions out of which five should be answered. Each question would carry twenty marks each. Each question shall carry a minimum of two and a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus.

MTF 106 (E) SOLAR THERMAL ENGINEERING

3 hours lecture per week

Sun and it's Energy: Solar spectrum, solar constant & solar radiations, Sun earth angles, solar hourly radiations-Radiations on Horizontal and inclined surfaces., solar radiation- solar radiation data, solar radiation geometry, empirical equations for predicting solar radiation, solar radiation on tilted surfaces, Measurement of Solar Radiation: Pyrheliometer, Pyranometer, Sunshine-Recorder.

Collection of Solar Energy : Flat plate collectors, classification, construction, heat transfer coefficients, optimisation of heat losses - Analysis of flat plate collectors, testing of collectors- Solar Air Heater : Description & classification, conventional air heater, air heater above the collector surface air heaters with flow on both sides of absorbers to pan air heater, air heater with finned absorbers, porous absorber

Thermal energy storage- sensible heat storage, latent heat storage , thermochemical storage. Solar Water heater: Collection cum storage water heater, Natural circulation & forced circulation water heater, shallow solar ponds. Solar Concentrators: Classification, characteristic parameters, types of concentrators materials in concentrators.

Passive Solar House: Thermal gain, Thermal cooling, Ventilation. Energy Storage: Sensible heat storage, Liquid, Solid, packed bed, Latent heat storage. Solar Distillation, Solar Cookers, Solar Refrigeration.

References:

1. F Kreith and J F Kreider: Principles of Solar thermal Engg.
2. J A Diffie and W A Beckman: Solar Engineering of Thermal processes
3. A B Meinel and F P Meinel: Applied Solar Engineering
4. S P Sukhatme: Solar Energy
5. Tiwari, G.N. and Sayesta Suneja., Solar Thermal engineering Systems, Narosa Publishing House.
6. Duffie and Backuran, Solar Thermal Engineering.
7. H.P. Gupta., Solar Engineering

Question Pattern:

There would be seven questions out of which five should be answered. Each question would carry twenty marks each. Each question shall carry a minimum of two and a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus.

MTF 107 (P) THERMAL SCIENCES LABORATORY

2 hours practical per week

Student shall design their own experiment by suitably modifying one of the existing experimental set ups in any of the laboratories of Thermal and Fluid stream under the supervision of Faculty-in-Charge of the Class and Staff-in-Charge, concerned Laboratory. They shall conduct the planned experiment and submit a detailed report on the experimental results obtained. The report shall also contain the detailed study carried out prior to designing the experiment. Marks will be awarded on the basis of the quality of the experiment conducted, the final report submitted, and oral examination conducted towards the end of the semester.

INTERNAL ASSESSMENT

Regularity -5 marks

Class work, Lab record, project report, viva – 30 marks

Test – 15 marks

Total internal continuous assessment – 50 marks

UNIVERSITY EVALUATION

Examination will be of 100 marks of which 70 marks are allotted for writing the procedures/formulae/calculation details/conducting the experiments /concluding results/plotting required graphs/inferences on the results etc. 20 marks for the Viva voce and 10 marks for the record.

No candidate will be permitted to attend the end-semester practical examinations unless he/she produces certified record of the laboratory.

MTF 108 (P) SEMINAR

2 hours practical per week

Each student shall prepare a seminar paper on any topic of his/her interest. However, the topic must be someway related to the core/elective courses being credited by him/her during the first or second semester. He/she shall get the paper approved by the Programme Coordinator/Faculty Advisor/any of the faculty members in the concerned area of specialization and present it in the class in the presence of Faculty in-charge, Seminar Class. Each student has to submit a seminar report. Every student shall participate in the seminar. Grade will be awarded on the basis of the quality of the paper, his/her presentation and participation in the seminar. A common format shall be given for reports of seminar and project. All reports of seminar and project submitted by students shall be in this given format.

INTERNAL ASSESSMENT

Presentation: 25

Report: 25

Total marks: 50

MTF 201 COMPUTATIONAL METHODS IN FLUID FLOW AND HEAT TRANSFER

3 hours lecture per week

Experimental, theoretical and numerical methods of predictions; physical and mathematical classifications partial differential equations; computational economy; numerical stability; validation of numerical results; round-off-error and accuracy of numerical results; iterative convergence, condition for convergence, rate of convergence; under – and over – relaxations, termination of iteration; tridiagonal matrix algorithm; discretization – converting derivatives to their finite difference forms – Taylor's series approach, polynomial fitting approach; discretization error.

Steady one-dimensional conduction in Cartesian and cylindrical coordinates; handling of boundary conditions; two – dimensional steady state conduction problems in Cartesian and cylindrical co-ordinates– point-by-point and line-by-line method of solution, dealing with Dirichlet, Neumann, and Robins type boundary conditions; formation of discritized equations for regular and irregular boundaries and interfaces; grid generation methods; adaptive grids.

One-, two, and three-dimensional transient heat conduction problems in Cartesian and cylindrical co-ordinates – explicit, implicit, Crank-Nicholson and ADI schemes; stability criterion of these schemes; conservation form and conservative property of partial differential and finite difference equations; consistency, stability and convergence for marching problems; discrete perturbation stability analysis, Fourier or von Neumann stability analysis.

Finite volume method for diffusion and convection–diffusion problems – steady one dimensional convection and diffusion; upwind, hybrid and power-law schemes, discretization of equation for two-dimension, false diffusion; Computation of the flow field using stream function–vorticity formulation; SIMPLE, SIMPLER, SIMPLEC and QUICK schemes, solution algorithms for pressure–velocity coupling in steady flows; numerical marching techniques, two-dimensional parabolic flows with heat transfer.

References:

1. Anderson, D. A, Tannehill, J. C., and R. H. Pletcher, R. H., Computational Fluid Mechanics and Heat Transfer,Second Edition, Taylor & Francis,1995.
2. T.J. Chung, Computational Fluid dynamics, Cambridge University Press, South Asian Edition,2003.
3. Muraleedhar, K. and T. Sundararaja, T. (eds.),Computational Fluid Flow and Heat Transfer, Second Edition, Narosa Publishing House, 2003.
4. Patankar, S. V., Numerical Heat Transfer and Fluid Flow, Hemisphere,1980.
5. Versteeg, H. K. and W. Malalasekera, W., An Introduction to Computational Fluid Dynamics: The Finite Volume Method, Addison Wesley–Longman,1995.
6. Hornbeck, R. W., Numerical Marching Techniques for Fluid Flows with Heat Transfer, NASA, SP – 297, 1973.

Question Pattern:

There would be seven questions out of which five should be answered. Each question would carry twenty marks each. Each question shall carry a minimum of two and a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus.

MTF 202/MTE 202 PRINCIPLES OF TURBO MACHINES

3 hours lecture per week

Definition and Classification of Turbo machines, Principles of operation, Specific work-representations on enthalpy entropy diagram. Fundamental equation of energy transfer, flow mechanism through the impeller, vane congruent flow, velocity triangles, ideal and actual flows, slip and its estimation, losses and efficiencies, degree of reaction, shape number and specific speed. Two dimensional cascades: cascade nomenclature, lift and drag, circulation and lift, losses and efficiency, compressor and turbine cascade performance, cascade test results, cascade correlations, fluid deviation, off –design performance, optimum space-chord ratio of turbine blades.

Axial flow turbines: Two dimensional theories. Velocity diagram, Thermodynamics, stage losses and efficiency, Soderberg's correlation, stage reaction, diffusion within blade rows, efficiencies and characteristics. Axial flow compressors: Two dimensional analysis. Velocity diagram, Thermodynamics, Stage losses and efficiency, reaction ratio stage loading, stage pressure rise, stability of compressors.

Three-dimensional flows in axial turbines: Theory of radial equilibrium, indirect and direct problems, compressible flow through a fixed blade row, constant specific mass flow rate, free vortex, off-design performance, blade row interaction effects. Centrifugal compressors: Theoretical analysis of centrifugal compressor, inlet casing, impeller, diffuser, inlet velocity limitations, optimum design of compressor inlet, prewhirl, slip factor, pressure ratio, choking in a compressor stage, Mach number at exit.

Radial Flow Turbines: Types of inlet flow radial turbines (IFR), thermodynamics of 90^{o} IFR turbine. Efficiency, Mach number relations, loss coefficient, off-design operating conditions, losses, pressure ratio limits.

References:

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.
7. H I H Saravanamuttoo, G F C Rogers, H Cohen: Gas Turbine Theory,2001
8. G F Wislicunes: Fluid Mechanics of Turbomachinery

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MTF 203/MTE 203 MEASUREMENTS IN THERMAL ENGINEERING

3 hours lecture per week

Characteristics of Measurement Systems - Elements of Measuring Instruments Performance characteristics - static and dynamic characteristics - Analysis of experimental data - Causes and types of experimental errors - Error & uncertainity analysis- statistical & graphical methods - probability distributions.

Temperature measurements - Theory, Thermal expansion methods, Thermoelectric sensors, Resistance thermometry, Junction semiconductor sensors, Pyrometry, Temperature measuring problems in flowing fluids, Dynamic Response & Dynamic compensation of Temperature sensors, Heat Flux measurements. Error estimates in Temperature measurements - Solids and fluids - Steady state and unsteady measurements -Radiation effects - Platinum resistance thermometers - Construction and usage – Calibration.

Fluid pressure measurement - Capacitive probes - Piezoelectric pressure sensors – Anemometry .High pressure & Low pressure measurements, Differential Pressure Transmitters. Laminar & Turbulent flow measurements - Determination of Reynolds stresses – Flow visualization techniques - Gross Volume Flow measurements - Measurement of Liquid level, Density, Viscosity, Humidity & Moisture, Compressible flow measurements.

Thermal Analysis Techniques - Measurements in combustion: Species concentration, Reaction rates, Flame visualization, Charged species diagnostics, Particulate size measurements. Temperature Measurements in high temperature gases - Calorimetric, electrostatic, radiation, cyclic, transient pressure and heat flux probes. Data Acquisition and Processing - General Data Acquisition system - Signal conditioning - Data transmission - A/D & D/A conversion - Data storage and Display - Computer aided experimentation.

References:

1. J P Holman : Experimental methods for Engineers
2. Ernest O Doeblin : Measurement Systems - Application & Design
3. Donald P Eckman : Industrial Instrumentation
4. Willard, Mertt, Dean,Settle : Instrumental Methods of analysis
5. D. Patranabis : Principles of Industrial Instrumentation
6. Beckwith & Buck : Mechanical Measurements
7. Nakra & Chaudary : Industrial Instrumentation
8. Physical Measurements in Gas Dynamics and Combustion : High Speed Aerodynamics and Jet Propulsion Vol. IX

Question Pattern:

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MTF 204(A) I. C. ENGINES SYSTEMS, COMBUSTION AND PERFORMANCE ANALYSIS

3 hours lecture per week

Working principle - Constructional details - Classification and application of different types of I.C. engines - Two stroke engines - Wankel and other rotary engines - Stirling engine. Mixture preparation systems for SI and CI engines – Carburettor – MPFI – Diesel fuel supply systems – fuel pumps - fuel injectors – unit injector - CRDI - Combustion chambers.

Ignition, lubrication and Cooling Systems - Speed Governing systems - Intake and exhaust systems - Supercharging methods - Turbocharger matching - Aero-thermodynamics of compressors and turbines. Engine testing and performance – Effects of engine design and operating parameters on performance and emissions; Pollution formation in SI and CI engines - Factors affecting emissions - Control measures for evaporative emissions - Thermal reactors and catalytic converters - Engine modifications to reduce emissions - Instrumentation to measure pollutants - Emission standards and testing.

Review of basic thermodynamics and gaseous mixtures- Reactant an product mixtures - Stoichiometry- Adiabatic flame temperature- First and Second Laws of Thermodynamics applied to combustion- Equilibrium products of combustion - Fundamentals of combustion kinetics – Elementary reaction rates. General characteristics of combustion flame – detonation - deflagration- Factors affecting flame velocity and thickness – Quenching- Flammability –Ignition - Flame stabilization Laminar premixed flames- Laminar diffusion flames Turbulent Premixed flames.

Fuels and their properties - Equivalence ratio – Self ignition temperature – Ignition lag- Role of fuel in engine combustion –Fuels for SI & CI engines – Octane number – Cetane number- Combustion generated pollutants. Normal combustion in SI Engines – Normal Combustion: Thermodynamic Analysis, Flame structure and speed, cyclic variations in combustion. Factors affecting combustion in SI engines –Effect of engine variables on flame propagation and ignition lag- Knocking- Effect of variables on knock – Detection of knock –Control of Knock- Pre ignition- Normal combustion in CI Engines –Analysis of cylinder pressure data – Direct Injection and Indirect – Injection Engine, Fuel spray behaviour - Variables affecting delay period - Factors affecting combustion in CI engines -Engine knock – Combustion chambers.

References:

1. Stephen R. T., An Introduction to Combustion, McGraw-Hill International Editions
2. Kuo, K. K., Principles of Combustion, John Willey & Sons, 1986.
3. Strehlow, R. A., Combustion Fundamentals, McGraw-Hill, 1985.
4. Mukunda, H. S., Understanding Combustion, Macmillan India Ltd., 1992.
5. Smith, M. L. and Stinson, K. W., Fuels and Combustion, McGraw-Hill, 1952.
6. Ashley S. C., Thermodynamic Analysis of Combustion Engines, John Wiley, 1979.
7. Heywood, J. B., Internal Combustion Engine Fundamentals, McGraw-Hill, 1989.
8. Maleev, M. L., Internal Combustion Engines, Second edition, McGraw-Hill, 1989.
9. Mathur, M. L. and Sharma, R. P., Internal Combustion Engines, Dhanpath Rai & Sons, 2005.
10. G. R. Pryling, "Combustion Engineering", Revised Edn., Combustion Engg. Inc., New York 1967.
11. A. C. Eckbreth, "Laser Diagnostics for Combustion Temperature and Species", Cambridge, Abacus Press, 1988.
12. B.P.Pundir, ‘I.C.Engines combustion and emissions’ Naroza Publishing 2010

Question Pattern:
There would be seven questions out of which five should be answered. Each question would carry twenty marks each. Each question shall carry a minimum of two and a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus.

MTF 204 (B) RENEWABLE ENERGY TECHNOLOGY

3 hours lecture per week

Solar energy – The Sun – Production and transfer of solar energy – Sun-Earth angles –Availability and limitations of solar energy – Measuring techniques and estimation of solar radiation – Solar thermal collectors – General description and characteristics – Flat plate collectors – Heat transfer processes – Short term and long term collector performance – Solar concentrators – Design, analysis and performance evaluation.

Energy storage – Sensible heat storage – Liquid media storage – Solid media storage – Dual media storage – Phase change energy storage – Storage capacity – Other storage methods – Solar dehumidification – Design, performance and applications – Combined solar heating and cooling systems – Performance and cost calculations – Special topics on solar energy.

Energy from biomass – Sources of biomass – Different species – Conversion of biomass into fuels – Energy through fermentation – Pyrolysis, gasification and combustion – Aerobic and anaerobic bio-conversion – Properties of biomass – Biogas plants – Types of plants – Design and operation – Properties and characteristics of biogas.

Wind energy – Principles of wind energy conversion – Site selection considerations –Wind power plant design – Types of wind power conversion systems – Operation, maintenance and economics – Geothermal energy – Availability, system development and limitations – Ocean thermal energy conversion – Wave and tidal energy – Scope and economics – Introduction to integrated energy systems. Small hydro – Geothermal energy – Fuel cell systems.

References:

1. J.A. Duffie and W.A. Beckman: Solar Energy Thermal Processes, J. Wiley, 1994
2. A.A.M. Saigh (Ed): Solar Energy Engineering, Academic Press, 1977
3. F. Kreith and J.F. Kreider: Principles of Solar Engineering, McGraw Hill, 1978
4. G.N. Tiwari: Solar Energy-Fundamentals, Design, Modelling and Applications, Narosa Publishers, 2002
5. H.P. Garg, S.C. Mullick and A.K. Bhargava: Solar Thermal Energy Storage, 1985
6. K.M. Mittal: Non-conventional Energy Systems-Principles, Progress and Prospects, Wheeler Publications, 1997
7. G.D. Rai: Non-conventional Energy Sources, Khanna Publishers, 2003

Question Pattern:

There would be seven questions out of which five should be answered. Each question would carry twenty marks each. Each question shall carry a minimum of two and a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus.

Kannur University

MTF 204 (C) FUELS AND COMBUSTION

3 hours lecture per week

Fuels-Types And Characteristics Of Fuels-Determination Of Properties Of Fuels-Fuels Analysis-Proximate And Ultimate Analysis-Moisture Determination-Calorific Value- Gross & Net Calorific Values – Calorimetry - Dulong's Formula For Cv Estimation-Flue Gas Analysis –Orsat Apparatus-Fuel & Ash Storage & Handling – Spontaneous Ignition Temperatures.

Solid fuels Types – Coal Family – Properties – Calorific Values – ROM, DMMF, DAG AND Bone Dry Basis – Ranking – Bulk & Apparent Density – Storage – Washability – Coking & Caking Coals – Renewable Solid Fuels – Biomass – Wood Waste – Agro Fuels – Manufactured Solid Fuels. Liquid Fuels Types – Sources – Petroleum Fractions- Classification – Refining – Properties Of Liquid Fuels – Calorific Value, Specific Gravity, Flash & Fire Point, Octane Number, Cetane Number Etc, - Alcohols – Tar Sand Oil – Liquefaction Of Solid Fuels. Classification – Composition & Properties – Estimation Of Calorific Value – Gas Calorimeter. Rich & Lean Gas – Wobbe Index – Natural Gas – Dry & Wet Natural Gas Stripped NG – Foul & Sweet NG – LPG – CNG – Methane – Producer Gas Gasifiers Water Gas – Town Gas – Coal Gasification – Gasification Efficiency – Non – Thermal Route – Biogas – Digesters – Reactions – Viability – Economics. Stoichiometry – Mass Basis & Volume Basis – Excess Air Calculation – Fuel & Flue Gas Compositions – Calculations – Rapid Methods – Combustion Processes – Stationary Flame Combustion Explosive Combustion. Mechanism Of Combustion – Ignition & Ignition Energy – Spontaneous Combustion- Flame Propagation – Solid, Liquid & Gaseous Fuels Combustion – Flame Temperature – Theoretical, Adiabatic & Actual – Ignition Limits – Limits Of Inflammability. Coal Burning Equipments – Types – Pulverized Coal Firing – Fluidized Bed Firing – Fixed Bed & Recycled Bed – Cyclone Firing – Spreader Stokers – Vibrating Grate Stokers Sprinkler Stokers, Traveling Grate Stokers. Oil Burners – Vaporizing Burners – Air Aspiration Gas Burners – Burners Classification According To Flame Structures – Factors Affecting Burners & Combustion.

References:

1. Samir Sarkar, Fuels & Combustion, 2nd Edition, Orient Logman,latest Edition
2. Bhatt,Vora Stoichiometry,2nd Edition, tata Mcgraw Hill, 1984
3. Blokh AG, Heat Transfer in Steam Boiler Furance, Hemisphere Publishing Corpn,1988
4. Civil Davies, Calculations in Furance Technology, Pergamon Press,Oxford,1966
5. Sharma SP,Mohan Chander,Fuels & Combustion, Tata Mcgraw Hill,1984

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MTF 204 (D) DESIGN AND OPTIMIZATION OF ENERGY SYSTEMS

3 hours lecture per week

Introduction: Introduction to system design, Morphology of design with a flow chart. Brief discussion on market analysis, profit, time value of money, an example of discounted cash flow technique Concept of workable design, practical example on workable system and optimal design.

System Simulation: Classification. Successive substitution method - examples. Newton Raphson method – one unknown - examples.Newton Raphson method - multiple unknowns – examples Gauss Seidel method - examples.Rudiments of finite difference method for partial differential equations, with an example.

Regression and Curve: Fitting,Need for regression in simulation and optimization, Concept of best fit and exact fit. Exact fit - Lagrange interpolation, Newton's divided difference -examples. Least square regression - theory, examples from linear regression with one and more unknowns -examples. Power law forms - examples. Gauss Newton method for non- linear least squares regression - examples.

Optimization: Introduction, Formulation of optimization problems – examples. Calculus techniques – Lagrange multiplier method – proof, examples. Search methods – Concept of interval of uncertainty, reduction ratio, reduction ratios of simple. Search techniques like exhaustive search, dichotomous search, Fibonacci search and Golden section search – numerical examples. Method of steepest ascent/ steepest descent, conjugate gradient method – examples. Geometric programming – examples. Dynamic programming – examples. Linear programming – two variable problem –graphical solution. New generation optimization techniques – Genetic algorithm and simulated annealing - examples. Introduction to Bayesian framework for optimization- examples.

References:

1. Prof. C. Balaji, Essentials of Thermal System Design and Optimization, Aue Books, New Delhi in India and CRC Press in the rest of the world.
2. Y.Jaluria, Design and optimization of thermal systems, Mc Graw Hill, 1998.
3. L.C.Burmeister,Elements of thermal fluid system design, Prentice Hall, 1998.
4. J.S.Arora, W.F .Stoecker, Design of thermal systems, Mc Graw Hill, 1989.
5. K.Deb, Optimization for engineering design - algorithms and examples, Prentice Hall, 1995.

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MTF 204 (E) TRANSPORT PHENOMENA

3 hours lecture per week

Viscosity and the mechanisms of momentum transfer: Newton's law of viscosity (molecular momentum transport), generalization of Newton's law of viscosity, pressure and temperature dependence of viscosity, molecular theory of the viscosity of gases at low density, molecular theory of the viscosity of liquids. Thermal conductivity and the mechanisms of energy transport: Fourier's law of heat conduction (molecular energy transport), temperature and pressure dependence of thermal conductivity, and theory of thermal conductivity of gases at low density.

Diffusivity and the mechanisms of mass transport: Fick's law of binary diffusion (molecular mass transport), temperature and pressure dependence of diffusivities, theory of diffusion in gases at low density. Shell momentum balances and velocity distributions in laminar flow: shell momentum balances and boundary conditions, flow of a falling film, flow through a circular tube, flow through annulus, flow of two adjacent immiscible fluids, creeping flow around a sphere.

Shell energy balances and temperature distributions in solids and laminar flow: shell energy balances; boundary conditions, heat conduction with an electrical heat source, heat conduction with a nuclear heat source, heat conduction with a viscous heat source, heat conduction with a chemical heat source, heat conduction through composite walls, heat conduction in a cooling fin, forced convection, free convection. Concentration distributions in solids and laminar flow: shell mass balances; boundary conditions, diffusion through a stagnant gas film, diffusion with a heterogeneous chemical reaction, diffusion with a homogeneous chemical reaction, diffusion into a falling liquid film (gas absorption), diffusion into a falling liquid film (solid dissolution), diffusion and chemical reaction inside a porous catalyst.

The equations of change for isothermal systems: the equation of continuity, the equation of motion, the equation of mechanical energy, the equation of angular momentum, the equations of change in terms of the substantial derivative, use of the equations of change to solve flow problems. Velocity distributions in turbulent flow: comparisons of laminar and turbulent flows, time- smoothed equations of change for incompressible fluids, the time- smoothed velocity profile near a wall. The equations of change for non-isothermal systems: the energy equation, special forms of the energy equation, the Boussenisq equation of motion for forced and free convection, use of the equations of change to solve steady state problems. The equations of change for multi component systems: the equations of continuity for a multi component mixture.

References:

1. Bird R.B., Stewart W.C., Lightfoot F.N.,Transport phenomena, 2nd ed. John Wiley & Sons Inc, U.S.A, 1960.
2. L. Theodore, Transport phenomena for engineers, International text book company,U.S.A.1971.
3. Transport processes and unit operations, 3rd, Geankoplis, PHI, 1997.
4. Welty, Wicks, Wilson, Fundamental of heat, momentum and mass transfer, John Wiley.

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MTF 205 (A) DESIGN OF HEAT TRANSFER EQUIPMENTS

3 hours lecture per week

Thermal performance analysis of heat exchangers - compact, cross flow, liquid to gas, and double pipe heat exchangers, film coefficients for tubes and annuli, equivalent diameter of annuli, fouling factors, caloric or average fluid temperature, true temperature difference; Design calculation of double pipe heat exchanger, LMTD ,NTU and P-NTU Methods.

Shell and tube heat exchangers- classification of shell and tube exchangers, Design calculation of shell and tube heat exchangers, shell-side film coefficients, shell-side equivalent diameter, true temperature difference in a 1-2 heat exchanger, influence of approach temperature on correction factor, shell and tube sides pressure drop; performance analysis of 1-2 heat exchangers, design calculation of shell and tube heat exchangers; flow arrangements for increased heat recovery. Thermal design of regenerators – classifications – governing equations – design parameters. Design of compact heat exchangers – plate and fin, fin-tube and plate and frame heat exchangers – fouling and corrosion in heat exchanger.

Direct contact heat transfer - Classification of cooling towers, wet-bulb and dew point temperatures, Lewis number, cooling-tower internals, heat balance, heat transfer by simultaneous diffusion and convection; Design and analysis of cooling towers, determination of the number of diffusion units, performance evaluation of cooling towers, influence of process conditions and operating variables on their design.

Heat pipes - types and applications, operating principles, working fluids, wick structures, control techniques, pressure balance, maximum capillary pressure, liquid and vapor pressure drops, effective thermal conductivity of wick structures, capillary limitation on heat transport capability, sonic, entrainment, and boiling limitations, Heat pipe design – fluid selection, wick selection, material selection, preliminary design considerations, heat pipe design procedure, determination of heat pipe diameter, design of heat pipe containers, wick design, entertainment and boiling limitations, design problems.

References:

1. Kern, D. Q., *Process Heat Transfer*, Tata McGraw-Hill, 2000.
2. Hewitt, Shires and Bolt, *Process Heat transfer,* CRC Press.
3. R K Shah, *Fundamentals of Heat Exchanger Design*, John Wiley & Sons.
4. Chi, S. W., *Heat Pipe Theory and Practice- A Source Book*, McGraw-Hill, 1976
5. Reay, D.A., Kew, P.A., *Heat pipes*, fifth edition, Butterworth-Heinemann publications, 2006.
6. Fraas, A. P., *Heat Exchanger Design*, Second Edition, John Wiley & Sons, 1989.
7. Dunn, P. D. and Reay, D. A., *Heat Pipes*, Fourth Edition, Pergamon Press, 1994.
8. El Wakil., *Power Plant Technology*, McGraw Hill.
9. Das, S.K., Prosess heat transfer, Narosa publishing house.2005

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MTF 205 (B) FIRE DYNAMICS

3 hours lecture per week

Energy Release Rates Basic definitions – burning rate or mass loss rate, combustion efficiency, energy release rate or heat release rate, Factors affecting energy release rates in fires, Energy release rates based on fire burn measurements – energy release rate, burning rate, heat of combustion and combustion efficiency, Pool fires – burning rate of pool fires, diameter dependence, steady burning of solids and liquids Fire Plumes and Flame Heights Flame characteristics – diffusion, buoyancy, turbulence, periodic instability of buoyant plumes and pool fires, mean flame height, flame height correlations, flame height of natural fires, Turbulent fire plume characteristics, Ideal plume- continuity equations, momentum and buoyancy equations along with solutions, Plume equations based on experiments – Zukoski plume, Heskestad plume, McCaffrey plume and Thomas plume, Ceiling jets Fire Science and Combustion Fuels and combustion process - nature of fuels, Physical chemistry of combustion in fires – ideal gas law, vapour pressure of fuels, combustion and energy release, mechanism of gas phase combustion, Temperature of flames Measurements in Fire Measurement of emissivity of a solid surface using emissometer, Measurement of temperature – thermocouples, seebeck effect, peltier effect, thermocouple laws, materials employed in standard thermocouples, thermocouple circuits, thermopiles, thermocouples treated as first order and second order system, response time of a thermocouple, Influence of radiation on thermocouple measurements in fire, Suction pyrometer (aspirated thermocouples), Plate thermometer for the measurement of temperature and heat flux, Thermal infrared pyrometry, Measurement of emissivity of fire using thermal camera and CCD camera, Cone calorimetry, Measurement of soot, spectral measurements Introduction to modeling of fire using Fire dynamics Simulator Governing equations – hydrodynamic model, combustion model, radiation model, solution algorithm, simulation of typical fires for gasoline and heptanes as fuel.

References:

1. Dougal Drysdale, An Introduction to Fire Dynamics, second edition, John Wiley and Sons, West Sussex, 1998.

2. Bjorn Karlsson and James G.Quintiere, Enclosure Fire Dynamics, CRC press, Florida, 2000

3. James G.Quintiere, Fundamentals of Fire phenomena, John Wiley and Sons, West Sussex, 2006

4. The SFPE Handbook of Fire Protection Engineering, fourth edition, National Fire Protection Association (NFPA), Masssachusetts, 2008

Question Pattern:

There would be seven questions out of which five should be answered. Each question would carry twenty marks each. Each question shall carry a minimum of two and a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus.

Kannur University

MTF 205(C)/204 (E) OPTIMISATION TECHNIQUES

3 hours lecture per week

Mathematical preliminaries: Mathematical programming problems-varieties and characteristics-Examples of problem formulation- difficulties caused by non- linearity-Convex sets-convex functions- concave functions- convex feasible region optimal solution-Quasi- convexity – unimodal function- Differentional functions-gradient and Hessian- properties of convex functions.

Unrestricted and classical optimization: search methods- Fibonacci search- Golden section search- Quadratic interpolation method- pattern search method-steepest descent method-Quasi Newton method- Hooke and Jeeves method-Lagrangier Multiplier method-Sufficiency condition- calculus of variations- Euler's equation-Necessary codition-transversality condition-problems with constraints

Constrained non-linear optimization: problems involving inequality constrainta-Kuhn-Tucker conditions-Quadratic programming – Wolfe's method- method of feasible directions-Frank and Wolf method- Convex simplex method- separable programming-Kelly's cutting plane method-Penalty and Barier methods

Integer and dynamic programming: dynamic programming- principles of optimality-tabular and calculus methods of solutions –Introduction to integer programming-Gomory's cutting plane method- Branch and Bound method

References:

1. Kambo,N.S, Mathematical programming techniques, Affiliated East West, 1984.
2. Intriligantor,M.D., Mathematical Optimization and Economic theory, Prentice Hall,1971.
3. Rao,S.S., Optimization theory and applications ,Wiley Eastern 1978.
4. Summons,D.L., Non-linear programming for operations research, prentice hall 1975.

Question Pattern:

There would be seven questions out of which five should be answered. Each question would carry twenty marks each. Each question shall carry a minimum of two and a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus.

MTF 205 (D) GAS TURBINES AND JET PROPULSION

3 hours lecture per week

Review of Gas Dynamics: Physical difference between incompressible, subsonic and supersonic flows, three reference speeds, dimensionless velocity, concepts of static and stagnation parameters. Pressure waves, finite, shock and detonation waves, compound waves, Analysis of piston excited waves, shock tubes, one-dimensional isentropic flow, normal shocks, Rayleigh flow, Fanno flow.

Gas Turbine Outline: Review of Thermodynamic principles, Gas turbine cycles, main components of Gas turbine power plants, performance characteristics, typical Gas Turbine Plants. Methods of improving efficiency and power output of gas turbine plants.

Design considerations of Centrifugal and axial flow compressors. Types of Gas turbine plants and their theory of operation, design consideration of gas turbine plants. Detailed study of main systems of gas turbine plants. Selection of materials of Gas turbine components. Trouble shooting, maintenance and actual performance evaluation of gas turbine plants. Recent development of gas turbine plants.

Jet Propulsion Outline: Basic theory of Jet & rocket propulsion devices and historical

development. Types of various jet propulsion plants like air screw, turboprop, turbojet, Ram jet, pulse jet, rocket propulsion, etc. and their comparative study. Performance study of various jet propulsion devices from ideal and practical consideration. Study and design considerations of main components of jet propulsion plants. Thrust augmentation devices and their thermodynamic analysis. Combustion performance, products of combustion and their properties. Recent advances in jet propulsion and Rocket propulsion devices.

References:

1. E. Rathakrishnan, Gas Dynamics, Prentice-Hall of India, New Delhi, 2002.
2. M.A. Saad, Compressible Fluid Flow, Prentice-Hall, New Jersey, 1985.
3. A. H. Shapiro, The Dynamics and Thermodynamics of Compressible Fluid Flow (2 volumes),

   The Ronald Press, New York, 1953.
4. Cohen, Rogers and Saravanamutto, Gas Turbine Fundamentals, Pearson Education.
5. Jack D. Mattingly, Jet Propulsion, McGraw Hill Inc.
6. V. Ganeshan, Gas Turbines, Tata-McGraw-Hill, New Delhi.
7. R. Yadav, Gas Turbines.

Question Pattern:

There would be seven questions out of which five should be answered. Each question would carry twenty marks each. Each question shall carry a minimum of two and a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus.

Kannur University

MTF 205 (E) AIRCONDITIONING SYSTEM DESIGN

3 hours lecture per week

Properties of moist air- Psychrometry, Psychrometric chart on enthalpy concentration and temperature concentration scales, Analysis of Psychrometric processes; sensible heating and cooling, Humidification and Dehumidification, sensible heat ratio; summer winter cycles. Air Heating and cooling, Air washers-humidification. Air filtering equipments and unitary equipment.

Air Conditioning systems: DX system,all water systems, all air systems-air water systems, heat pump system, central and unitary systems, fan coil systems. Air movement in rooms, Air distribution devices, Air curtains.

Estimation of cooling load, duct design; Special purpose Air Conditioning such as theatres, computer room, school, libraries, rail cars, aircraft and ships.

Automatic controls of air conditioning systems, thermostats, dampers and damper motors, automatic valves. Noise control and acoustic problems.

References:

1. Harris NC : Air conditioning practice
2. Gunther R C : Air conditioning and cold storage
3. Stoeker W F : Refrigeration and Air conditioning and Ventilation of Buildings
4. ASHRAE guide and Data Book
5. 1993 ASHRAE Handbook - Fundamentals.
6. 1992 ASHRAE Handbook - HVAC Systems and Equipment.

Question Pattern:

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MTF 206 (A) AERODYNAMICS

3 hours lecture per week

Equations for incompressible inviscid flows, Fluid circulation and rotation, Vorticity, Kelvin's theorem, Velocity potential, Stream function, Equation of a stream line, Complex potential, Blasius theorem for force and moment on bodies, Elementary flow patterns and their superposition.

Flow past a cylinder, Magnus effect, Kutta condition, Vortex theory of lift, Conformal transformation, The Jowkowski transformation, Lift on arbitrary cylinder, Aerodynamic center, Pitching moment.

Aerofoils, Low speed flows over aerofoils-the vortex sheet, Thin aerofoil theory, Symmetric aerofoil, Tear drop theory, Camber line at zero angle of attack, Characteristics of thin aerofoils, Motion in three dimensions, Flow past slender bodies.

Finite wings, Downwash and induced drag, Prandtl-Lachester theory, Biot- Savarat law, General series solution, Glauret method, Multhop's method, Horseshoe effects, Ground effects, Lineraised compressible flows in two dimensions, Flow past a wavy wall, Similarity rules, Aerofoil in compressible flows.

References:

1. Kuethe, A. M. and Chow, C., Foundations of Aerodynamics, Fourth Edition, Wiley Eastern, 1986
2. Katz, J. and Plotkin, A., Low Speed Aerodynamics, McGraw-Hill, 1991.
3. Milne-Thomson, L. M., Theoretical Hydrodynamics, Macmillan, 1958
4. Anderson Jr., J. D., Fundamentals of Aerodynamics, McGraw Hill, 1988.
5. Houghton, E. L. and Brock, A. E., Aerodynamics for Engineering Students, Second Edition, Edward Arnold, 1970

Question Pattern:

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Kannur University

MTF 206(B) BOUNDARY LAYER THEORY

3 hours lecture per week

Basic concepts, B.L. Parameters, B.L. on flat plate, stokes first and second problems, Hiemenz flow, flow near rotating disc. Von-Karman Momentum Equation. General Properties of B.L. equations, momentum and energy B.L. Equations.

Exact solution of two dimensional methods. Theory of stability. Perturbation methods, OrrSomerfield equation, general properties of disturbance equations. Tollmien s method of solution. Thermal B.L. in Laminar flow. Theory of similarity in heat transfer and exact solutions. Turbulence, correlation coefficient.

Laminar Boundary Layer on a Flat Plate at zero incidence, Turbulent Boundary Layer on a Flat plate at zero incidence, Fully Developed Turbulent Flow in a pipe, Boundary Layer on an airfoil, Boundary Layer separation

Internal Flows –Two-Layer Structure of the velocity Field – Universal Law of the wall – Friction law – Fully developed Internal flows – Chennel Flow, Couettee – Poiseuille flows, Pipe Flow.

References:

1. H. Schlichting, Boundary Layer Theory, McGraw Hill , 1979.
2. J.C. Hinze, Turbulence - An introduction to its Mechanism and Theory, McGraw-Hill, 1975.
3. J.C. Hinze, Turbulence - An introduction to its Mechanism and Theory, McGraw-Hill, 1975.

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MTF 206 (C) INTRODUCTION TO TURBULENCE

3 hours lecture per week

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).

References:

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.

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MTF 206 (D) ROBUST DESIGN

3 hours lecture per week

Introduction: Planning of experiments, terminology, Anova rationale, basics of quality by design.

Factorial Experiments: Single factor and multi factor experiments, tests on means, EMS rules.

Robust design process : Comparison of classical and Taguchi's approach, variability due to noise factors, principle of robustization, classification of quality characteristics and parameters, objective functions in robust design, S/N ratios.

Orthogonal Experiments: Selection and application of orthogonal arrays for design, Conduct of experiments, collection of data and analysis of simple experiments, Modifying orthogonal arrays.

Product/process optimization: Inner and outer OA experiments, Optimization using S/N ratios, attribute data analysis, a critique of robust design.

References:

1. Phillip J.Rose, Taguchi techniques for quality engineering, Prentice Hall, 1989
2. D.C.Montgomery,Design and Analysis of experiments, John Wiley and Sons, 1984
3. Nicolo B elavendram , Quality by Design; Taguchi techniques for industrial experimentation, Prentice Hall, 1995.

Question Pattern:

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MTF 206 (E) NUCLEAR ENGINEERING

3 hours lecture per week

Review of elementary nuclear physics. Nuclear Reactions and Radiations: Principles of radioactive decay- interaction of α, β & γ rays with matter- neutron cross sections and reactions- the fusion process-chain reaction. Basic principles of controlled fusion. Nuclear model of the atom - Equivalence of mass and energy - Binding - Radio activity - Half life - Neutron interactions - Cross sections

Nuclear reactor principles: Reactor classification-critical size- basic diffusion theory-slowing down of neutrons-neutron flux and power-four factor formula-criticality condition-basic features of reactor control. Boiling water reactor: Description of reactor system-main components-control and safety features.

Materials of reactor construction: Fuel, moderator, coolant-structural materials-cladding – radiation damage. Nuclear fuels: Metallurgy of uranium-general principles of solvent extraction-reprocessing of irradiated fuel-separation process- Fuel enrichment. Nuclear fuel cycles - spent fuel characteristics - Role of solvent extraction in reprocessing - Solvent extraction equipment. Reactors - Types of reactors - Design and construction of fast breeding reactors - heat transfer techniques in nuclear reactors –

Reactor Heat Removal: Basic equations of heat transfer as applied to reactor cooling-Reactor heat transfer systems-heat removed in fast reactors. Radiation safety: Reactor shielding-radiation dozes- standards of radiation protection- nuclear waste disposal. Nuclear plant safety- Safety systems - Changes and consequences of an accident - Criteria for safety - Nuclear waste - Type of waste and its disposal - Radiation hazards and their prevention - Weapons proliferation.

References:

1. S.Glasstone and A. Sesonke, Nuclear Reactor Engineering (III Ed.), Von.Nostrand,1981..
2. E.E.Lewis, Nuclear reactor safety, Wiley Interscience, 1977.
3. J.Weisman (Ed), Elements of Nuclear reactor design, Elsevier Scientific Pub.Co., 1977.
4. J. R. Lamarsh and A. J. Baratta, Introduction to Nuclear Engineering 3rd Edition, Prentice Hall, 2001.
5. Source book on Atomic Energy- S.Glasston
6. Thomas J. Cannoly, "Fundamentals of Nuclear Engineering ", John Wiley (1978).
7. Collier J.G., and G.F.Hewitt, "Introduction to Nuclear Power ", (1987), Hemisphere Publishing, New York.
8. Lipschutz R.D. " Radioactive Waste - Politics, Technology and Risk ", (1980), Ballingor, Cambridge. M.A

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MTF 207 (P) LABORATORY – COMPUTATIONAL LAB

2 hours practical per week

1. Development of algorithms and computer programs using FORTRAN, C, MATLAB, MATHEMATICA, MATHCAD etc.
2. Numerical integration of ordinary differential equations: Initial value problems
3. Numerical Solution of ordinary differential equations: Boundary value problems
4. Numerical solution of partial differential equations
5. Two dimensional boundary layer computer programming for wall boundary layer and free shear layers with applications in laminar and turbulent flow with and without heat and mass transfer and combustion.
6. Hands-on Training on the following Software:
    - Design, modelling and analysis: using ANSYS, PRO-E,
    - CFD analysis using FLUENT, CFX etc.

References

1. S.C.Chapra and R.P. Canale: *Numerical Methods for Engineers*, 2e, McGraw Hill, 1990
2. Y. Jaluria: *Computer Methods for Engineers*, 2e, McGraw Hill, 1990
3. J.M.L. Smith and J.C. Wolford: *Applied Numerical Methods for digital computation*, Harper & Row, 1977

INTERNAL ASSESSMENT:

Regularity -5 marks

Class work, Lab record, and viva – 30 marks

Test – 15 marks

Total internal continuous assessment – 50 marks

UNIVERSITY EVALUATION:

Examination will be of 100 marks of which 70 marks are allotted for writing the procedures/formulae/simple calculation details/conducting the experiments /concluding results/plotting required graphs/inferences on the results etc. 20 marks for the Viva voce and 10 marks for the record.

MTF 208 (P) TERM PAPER

2 hours practical per week

The student is expected to present a report on the literature survey conducted as a prior requirement for the project to be taken up in third and fourth semesters. Head of department can combine TP hours of many weeks and allot a maximum of four weeks exclusively for it. Student should execute the project work using the facilities of the institute. However external project can be taken up, if that work solves a technical problem of the external firm. Prior sanction should be obtained from head of department before taking up external project work. Project evaluation committee should study the feasibility of each project work before giving consent. An overview on the project work should be introduced before the closing of the first semester. A paper should be prepared based on the project results and is to be published refereed conferences /journals

INTERNAL ASSESSMENT

Presentation: 25

Report: 25

Total marks: 50

MTF 301 (P) THESIS PRELIMINARY

The student will be encouraged to fix the area of the project work and conduct the literature review during the second semester itself. The project work starts in the third semester. The topic shall be research and development oriented. The project can be carried out at the institute or in an industry/research organization. Students desirous of carrying out project in industry or other organization have to get the prior permission. They are supposed to complete a good quantum of the work in the third semester. There shall be evaluation of the work carried out in the third semester.

Weightage for the 8 credts allotted for thesis preliminary

Evaluation of thesis- Preliminary work by the guide-50% (200 marks)

Evaluation of thesis- Preliminary work- by the evaluation committee-50% (200 marks)

MTF 401 (P) THESIS

The project work started in the third semester will be extended to the end of the fourth semester. The project can be carried out at the institute or in an industry/research organization. Students desirous of carrying out project in industry or other organization have to get the prior permission. There shall be evaluations of the project work by a committee constituted by the department and by an external examiner.

Weightage for the 12 credits allotted for thesis

Internal evaluation of the thesis work: by the guide – (200marks)

Internal evaluation of the thesis work: By the evaluation committee-(200 marks)

Final Evaluation of the thesis work - by the internal and external examiners: - (Evaluation of the thesis + Viva voce) - (100+100 marks)