Second Semester
M.Tech (Thermal Engineering)
MTE 201: EQUIPMENT DESIGN FOR THERMAL SYSTEMS

Unit - 1: Classification of heat exchangers: Introduction, Recuperation & Regeneration – Tubular heat exchangers: double pipe, shell & tube heat exchanger, Plate heat exchangers, Gasketed plate heat exchanger, spiral plate heat exchanger, Lamella heat exchanger, extended surface heat exchanger, Plate fin, and Tubular fin.
Basic Design Methods of Heat Exchanger: Introduction, Basic equations in design, Overall heat transfer coefficient – LMTD method for heat exchanger analysis – parallel flow, counter flow, multipass, cross flow heat exchanger design calculations.

Unit - 2: Shell & Tube Heat Exchangers: Tube layouts for exchangers, baffle Heat exchangers, calculation of shell and tube heat exchangers – shell side film coefficients, Shell side equivalent diameter, the true temperature difference in a 1-2 heat exchanger, influence of approach temperature on correction factor, shell side pressure drop, tube side pressure drop, Analysis of performance of 1-2 heat exchanger, and design calculation of shell & tube heat exchangers. Flow arrangements for increased heat recovery, the calculations of 2-4 exchangers.

Unit - 3: Vaporizers, Evaporators and Reboilers: Vaporizing processes, forced circulation vaporizing exchangers, natural circulation vaporizing exchangers, calculations of a reboiler.

Unit – 4: Extended Surfaces: Longitudinal fins, weighted fin efficiency curve, calculation of a double pipe fin efficiency curve, and calculation of a double pipe finned exchanger, calculation of a longitudinal fin shell and tube exchanger.

Unit - 5: Direct Contact Heat Exchanger: Cooling towers, relation between wet bulb & dew point temperatures, the Lewis number, and classification of cooling towers, cooling tower internals and the roll of fill, Heat balance, heat transfer by simultaneous diffusion and convection. Analysis of cooling tower requirements, Design of cooling towers, Determination of the number of diffusion units, calculation of cooling tower performance.

TEXT BOOKS :

1. Process Heat Transfer – D.Q. Kern, TMH.
2. Cooling Towers by J.D. Gurney
3. Heat Exchanger Design – A.P.Fraas and M.N. Ozisick. John Wiely & sons, New York.

MTE 202: REFRIGERATION AND AIR CONDITIONING

Unit – 1: Vapour Compression Refrigeration: Performance of Complete vapor compression system. **Components of Vapor Compression System:** The condensing unit – Evaporators – Expansion valve – Refrigerants – Properties – ODP & GWP - Load balancing of vapor compression Unit.
Compound Compression: Flash inter-cooling – flash chamber – Multi-evaporator & Multistage systems.

Unit – 2: Production of low temperature – Liquefaction system ;Cascade System – Applications.– Dry ice system.
Vapor absorption system – Simple and modified aqua – ammonia system – Representation on Enthalpy –Concentration diagram. Lithium – Bromide system Three fluid system – HCOP.

Unit – 3: Air Refrigeration: Applications – Air Craft Refrigeration -Simple, Bootstrap, Regenerative and Reduced ambient systems – Problems based on different systems.
Steam Jet refrigeration system Representation on T-s and h-s diagrams – limitations and applications.
Unconventional Refrigeration system – Thermo-electric – Vortex tube & Pulse tube – working principles.

Unit – 4: Air –conditioning: Psychrometric properties and processes – Construction of Psychrometric chart. Requirements of Comfort Air –conditioning – Thermodynamics of human body – Effective temperature and Comfort chart – Parameters influencing the Effective Temperature. Summer , Winter and year round air – conditioning systems. Cooling load Estimation: Occupants, equipments, infiltration, duet heat gain fan load, Fresh air load.

Unit – 5: Air –conditioning Systems: Re-circulated air with & without bypass, with reheat systems – Calculation of Bypass Factor, ADP, RSHF, ESHF and GSHF for different systems.
Components: Humidification and dehumidification equipment – Systems of Air cleaning – Grills & diffusers – Fans & blowers – Measurement & control of Temperature & Humidity.

TEXT BOOKS :

1. Refrigeration & Air Conditioning – C.P. Arora(TMH)
2. Refrigeration & Air Conditioning – Arora & Domkundwar – Dhanpat Rai

REFERENCE BOOKS :

1) Refrigeration and Air Conditioning :Manohar Prasad
2) Refrigeration and Air Conditioning : Stoecker – Mc Graw Hill
3) Principles of Refrigeration – Dossat (Pearson)
4) Refrigeration and Air Conditioning : Ananthanarayana (TMH)
5) Refrigeration and Air Conditioning : Jordan and – Prentice Hall, Preister
6) Refrigeration and Air Conditioning : Dossat – Mc Graw Hill
7) Thermal Environmental Engg. : Threlkeld – Van Nostrand
8) Refrigeration and Air Conditioning : Ballany – Khanna
9) Refrigeration and Air Conditioning : SC Jain S.Chand and Co.

MTE 203: FUNDAMENTALS OF GAS DYNAMICS

UNIT 1: Fundamental Aspects of Gas Dynamics: Introduction, Isentropic flow in a stream tube, speed of sound, Mach waves; One dimensional Isentropic Flow: Governing equations, stagnation conditions, critical conditions, maximum discharge velocity, isentropic relations ; Normal Shock Waves: Shock waves, stationary normal shock waves, normal shock wave relations in terms of Mach number;

UNIT 2: Oblique Shock Waves: Oblique shock wave relations, reflection of oblique shock waves, interaction of oblique shock waves, conical shock waves; Expansion Waves: Prandtl-Meyer flow, reflection and interaction of expansion waves, flow over bodies involving shock and expansion waves ; Variable Area Flow: Equations for variable area flow, operating characteristics of nozzles, convergent-divergent supersonic diffusers ; Adaiabatic Flow in a Duct with Friction: Flow in a constant area duct, friction factor variations, the Fanno line ;

UNIT 3: Flow with Heat addition or removal: One-dimensional flow in a constant area duct neglecting viscosity, variable area flow with heat addition, one-dimensional constant area flow with both heat exchanger and friction ; Generalized Quasi-One-Dimensional Flow: Governing equations and influence coefficients, solution procedure for generalized flow with and without sonic point

UNIT 4: Two-Dimensional Compressible Flow: Governing equations, vorticity considerations, the velocity potential, linearized solutions, linearized subsonic flow, linearized supersonic flow, method of characteristics.

Text Books

L. D. Landau and E. M. Lifshitz, Fluid Mechanics. 2nd ed., Butterworth-Heinemann, 1995.
H. W. Liepmann, and A. Roshko, Elements of Gas Dynamics, Dover Pub, 2001.

References

P. H. Oosthuizen and W. E. Carscallen. Compressible Fluid Flow. NY, McGraw-Hill, 1997.
M. A. Saad, Compressible Fluid Flow. 2nd ed. Upper Saddle River, NJ: Prentice-Hall, 1993.
F. M. White, Viscous Fluid Flow. 2nd ed. New York: McGraw-Hill, 1991.
A. H. Shapiro, Compressible Fluid Flow 1 and 2. Hoboken NJ: John Wiley.

MTE 204: THERMAL AND NUCLEAR POWER PLANTS

Unit - 1: Introduction – Sources of Energy, types of Power Plants, Direct Energy Conversion System, Recent developments in Power Generation. Steam Power Plants: Modern Coal-fired Steam Power Plants, Power Plant cycles, Combustion Equipment. Steam Generators: Types, Performance of Boilers, Cooling Towers, Steam Turbines, Compounding of Turbines, Condensers.

Unit - 2: **Gas Turbine Power Plant**: Co-generation, Combined cycle Power Plants, Analysis, Waste-Heat Recovery, IGCC Power Plants, Fluidized Bed Combustion.

Unit -3: Nuclear Power Plants: Nuclear Reactors, Classification – Types of Reactors, Methods of enriching Uranium, Thorium nuclear reactors, Nuclear Power Plants Safety: By-Products of Nuclear Power Generation, Economics of Nuclear Power Plants, Nuclear Power Plants in India, Future of Nuclear Power.

Unit -4: Economics of Power Generation: Factors affecting the economics, Load Factor, Utilization factor, Performance and Operating Characteristics of Power Plants. Economic Load Sharing, Depreciation, Energy Rates, Specific Economic energy problems.

Unit - 5: Power Plant Instrumentation: Classification, Pressure measuring instruments, Temperature measurement and Flow measurement. Analysis of Combustion gases, Methods to Control.

TEXT BOOKS:

1. Power Plant Engineering / P.K. Nag / TMH.
2. Power Plant Engineering / R.K. Rajput / Lakshmi Publications.
3. Power Plant Engineering / P.C.Sharma / Kotaria Publications.
4. Power Plant Technology / Wakil.

MTE 205: RENEWABLE ENERGY ENGINEERING

Unit – 1: Introduction – Energy Scenario, Survey of Energy Resources, Classification, Need for Non-Conventional Energy Resources. Solar Energy, Solar radiation, Radiation measuring instruments. **Solar Energy Applications:** Solar water Heating, space heating – active and passive heating – energy storage – selective surface – solar stills and ponds – solar refrigeration – photovoltaic generation.

Unit - 2: Geothermal Energy: Structure of Earth – Geothermal Regions – Hot springs – Hot Rocks – Hot Aquifers – Analytical Methods to estimate Thermal Potential – Harnessing Techniques – Electricity Generating Systems.

Unit - 3: Hydrogen Fuel – Production methods – Properties – I.C. Engines Applications – Utilization Strategy – Performances. Advantages and disadvantages.

Unit – 4: Energy from Oceans: Tidal Energy; Tides – Diurnal and Semi – Diurnal Nature – Power from Tides. Wave Energy; Waves – Theoretical Energy Available – Calculation of period and phase velocity of waves – wave power systems – submerged devices. Ocean Thermal Energy: principles – Heat Exchangers – Pumping requirements – Practical Considerations

Unit – 5: Wind Energy: Wind – Beaufort number – characteristics – wind energy conversion systems – types – Betz model – Interference Factor – Power Coefficient – Torque Coefficient and thrust coeff.- Lift machines and drag machines – matching – electricity generation.

TEXT BOOKS:

1. Renewable Energy Resources – Basic Principles and Applications – G.N.Tiwari and M.K.Ghosal, Narosa Pub

REERENCE BOOKS :

1. Renewable Energy Resources / John Twidell & Tony Weir
2. Biological Energy Resources / Malcolm Flescher & Chrris Lawis