

M. TECH. (HEATING VENTILATION AND AIR CONDITIONING)-R13 Regulations**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD***(Established by an Act No.30 of 2008 of A.P. State Legislature)***Kukatpally, Hyderabad – 500 085, Andhra Pradesh (India)****M. TECH. (HEATING VENTILATION AND AIR CONDITIONING)
COURSE STRUCTURE AND SYLLABUS****I Year I Semester**

Code	Group	Subject	L	P	Credits
		Refrigeration	3	0	3
		Air Conditioning-I	3	0	3
		Heating System	3	0	3
		Ventilation System	3	0	3
	Elective –I	Food Processing Technology Non-Conventional Energy Sources Advanced Thermodynamics	3	0	3
	Elective -II	Computational Fluid Dynamics Maintenance Management Material Science	3	0	3
	Lab	Refrigeration Lab	0	3	2
		Seminar	-	-	2
		Total Credits	18	3	22

I Year II Semester

Code	Group	Subject	L	P	Credits
		Advanced Heat and Mass Transfer	3	0	3
		Air-Conditioning -II	3	0	3
		Advance Instrumentation Control Systems	3	0	3
		Refrigeration &A/C Equipments & Control	3	0	3
	Elective –III	Energy Management Equipment Design for Thermal Systems Advanced Finite Element Analysis	3	0	3
	Elective -IV	Thermal and Nuclear Power Plants Cryogenic Engineering Turbo Machines	3	0	3
	Lab	Air-Conditioning Lab	0	3	2
		Seminar	-	-	2
		Total Credits	18	3	22

II Year - I Semester

Code	Group	Subject	L	P	Credits
		Comprehensive Viva	-	-	2
		Project Seminar	0	3	2
		Project work	-	-	18
		Total Credits	-	3	22

II Year - II Semester

Code	Group	Subject	L	P	Credits
		Project work and Seminar	-	-	22
		Total Credits	-	-	22

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
I Year -I Sem. M.Tech (HV&AC)

REFRIGERATION

UNIT-I:

VAPOUR COMPRESSION SYSTEM: Analysis of vapour compression refrigeration cycle Reverse Carnot Cycle for vapour. Effect of suction temperature and condensing temperature on cycle performance. Practical refrigeration cycle, Sub cooled liquid and super heated vapour refrigeration cycles, their effect on performance. Multi-pressure system. Removal of flash gas, inter cooling. Compound compression- Multi vapour- Cascade system- dry ice system

UNIT -II:

VAPOUR ABSORPTION SYSTEM: Simple vapour Absorption system-Actual vapour absorption cycle-representation on enthalpy concentration h-c diagram, Water lithium bromide absorption system. Electrolux refrigerator- Aqua Ammonia Refrigeration System.

UNIT-III:

AIRCRAFT REFRIGERATION: Steam jet water vapour system, thermoelectric refrigeration system, Vortex refrigeration system, Pulse refrigeration.

UNIT-IV:

INDUSTRIAL REFRIGERATION: Chemical and process industries, Dairy plants, Petroleum Refineries

UNIT-V:

REFRIGERANTS: Primary and secondary refrigerants. Designation of refrigerants, Desirable properties of refrigerants such as solubility in water and lubricating oil. Material compatibility, Toxicity, Flammability, Thermodynamic properties of refrigerants, Inorganic, Halo carbon refrigerants. Secondary refrigerants. Refrigerants mixtures, Newer refrigerants.

REFERENCES:

1. R&AC / C.P Arora./ TMGn).
2. R&AC / Manohar Prasad.
3. R&AC / F. Stoecker & Jerold. W. Jones./ MGH Intrl 1982
4. Principles of Refrigeration / Roy. J. Dossat./.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
I Year -I Sem. M.Tech (HV&AC)

AIR CONDITIONING - I

UNIT - I:

PSYCHROMETRY: Properties of moist air. Important Psychrometry properties, Dry bulb temperature, Humidity ratio, degree of saturation, Dew point temperature and Enthalpy, Psychrometric chart and ASHRAE chart. Psychrometric process in air conditioning equipment, Bypass factor and sensible heat factor.

UNIT - II:

APPLIED PSYCHROMETRY: Use of Effective and grand sensible heat factor, Selection of air conditioning equipment for cooling and dehumidification. High latent cooling load applications, All outdoor air applications.

UNIT - III:

AIR CONDITIONING PROCESSES: Mixing process- Summer, winter and year round air Conditioning system, Hot and dry outdoor conditions. Hot and humid outdoor conditions. Winter air conditioning system. Year round air conditioning system.

UNIT - IV:

PROCESS OF COOLING: Heating and dehumidifying coils, Air washers. Cooling by dry and wet coils, Use of hygroscopic solution in air washers, Adiabatic dehumidifiers. Humidifiers, Water injection. Steam injection.

UNIT - V:

COMFORT AIR CONDITIONING: Thermodynamics of human body. Body regulation process against heat and cold. Comfort & Comfort chart, Effective temperature, Factors governing optimum effective temperature, Design consideration. Selection of outside and inside design conditions, Air conditioning control systems, basic elements of the control system, Temperature, Humidity & Pressure controls, Refrigeration, Room thermostat.

REFERENCES:

1. Refrigeration & Air Conditioning / C.P.Arora / TMH
2. Refrigeration & Air Conditioning / Arora & Domkundwar / Dhanpat Rai & Co.
3. Refrigeration & Air Conditioning / R C Arora / PHI / 2012
4. Hand Book of Air Conditioning System Design / Carrier
5. Refrigeration & Air Conditioning / S.C. Jain / Chand and Co.
6. ASHRAE Hand Book / Volume 1& 2.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
I Year -I Sem. M.Tech (HV&AC)

HEATING SYSTEM

UNIT-I:

BUILDING SURVEY-location of equipment. Heat gain through glass-calculation of solar heat gain through ordinary glass tables-shading devices-effect of shading devices. Thermal resistance of various building materials.

UNIT-II:

HEAT TRANSFER THROUGH BUILDING STRUCTURES: Periodic heat transfer through walls and roofs. Empirical methods to calculate heat transfer through walls and roofs using decrement factor and time lag method. Equivalent temperature difference method. Infiltration-tack effect-wind effect.

UNIT-III:

HEATING LOAD CALCULATIONS: Winter heating load calculation-heat losses through structure-heat losses due to infiltration. Effects of solar radiation and internal heat sources on heating loads. Methods for estimating energy requirements for heating.

UNIT-IV:

AIR HEATING SYSTEM: Classification - gravity warm heating system, forced warm air heating system-balancing a warm air heating system, warm air furnaces, air cleaners, humidifiers & De-humidifiers, advantages & Disadvantages of warm air heating system. Common problems and remedies of warm air heating system.

UNIT- V:

HOT WATER HEATING SYSTEM OR HYDROULIC HEATING SYSTEM: Classification-based on water circulation, piping arrangement i.e. one pipe system, two pipe direct return system, gravity hot water system. One pipe & two pipe gravity hot water heating. Forced hot water heating system, gas boilers, circulating pump, radiation

REFERENCES:

1. HVAC Fundamentals Volume-I / James E. Brumbou / Audel / 4th Edition
2. Fundamentals of HVAC Systems / Robert Mcdowall / Academic Press / 2007
3. Home Heating & Air Conditioning systems / James Kittle / MGH
4. HVAC Fundamentals / Samuel C. Sugarman / Fairmont Press / 2005.
5. R&AC Hand Book by ISHRAE

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
I Year -I Sem. M.Tech (HV&AC)

VENTILATION SYSTEM

UNIT-I:

Introduction- Fundamentals of good indoor air quality Need for building ventilation, Effects of R.H. in building ventilation, Control of microbial growth, Psychometric performance of contact volume system. Types of ventilation system. Supply system, Exhaust system.

UNIT -II:

DEVICES USED IN SUPPLY SYSTEMS: Air Inlet system. Filters heating & cooling equipment, Fans, Duct, Grills, Diffusers, For distribution of air in the work place.

UNIT-III:

EXHAUST SYSTEMS: General exhaust systems. Local exhaust system, Removal of pollutants and contaminated air. Air cleaning devices, Fans.

UNIT-IV:

VENTILATION IN KITCHEN: Cooking, Exhaust flow, IMC (International Mechanical Code) Calculation of appliances area, Contaminated air, Free foot area. Total air flow volume with example. Types of hood, Design of hood. Design factors, Integrated air curtains, Combination hood.

UNIT-V:

VENTILATION OF COMMERCIAL BUILDING: Design of commercial, Residential ventilation system.

REFERENCES:

1. Ventilation Systems: Design and Performance/ Hazim B. Awbi. / Routledge / 2007.
2. Portable Ventilation Systems Hand Book / Neil McManus / CRC Press / 2000.
3. Design of Industrial Ventilation Systems / John L Alden / Industrial Press / 5th Edition.
4. Industrial Ventilation Applications / ISHRAE Hand Book / 2009.
5. Engineering bulletin / TRANE Company.
6. HVAC Hand book / ISHRAE.
7. Industrial Ventilation Applications / ASHRAE Hand Book / 2009.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
I Year -I Sem. M.Tech (HV&AC)

FOOD PROCESSING TECHNOLOGY
(Elective-I)

UNIT-I:

THEORIES AND METHOD OF CHILLING: Freezing and free de-humidification, Preparation for freezing, Freezing methods. Commercial freezing methods, Sharp, quick and air blast freezing, Freezing drying - Methods of pre-cooling fruits and vegetables, Hydro cooling, Forced air cooling and Vacuum cooling.

UNIT-II:

PROCESSING OF MEAT PRODUCTS: Refrigeration systems for carcass chilling and holding, Chilled brine spray, Sprayed coil, Dry coil systems. Chilling and freezing variety meats, Overnight chilling, Quick chilling. Effect of freezing temperature on quality of meat products.

Fishery Products: Icing of fish. Saltwater icing. Freezing methods, Slow freezing Blast freezing, Plate Freezing and Immersion freezing offish.

UNIT-III:

DAIRY PRODUCTS: Milk processing, Handling, Dairy plant procedure. Standardizing, Pasteurization, Homogenizing and Container filling.

Fruit Juice Concentrations: Processing and quality control selection, Grading and handling of fresh fruit, Washing, Juice extraction, Heat Treatment, Flavour fortification, Packing storage and distribution, Convection methods, freezing and mechanical separation. Low temperature vacuum evaporation, Direct refrigerant contact method. Indirect refrigerant contact methods, High temperature short time evaporations.

UNIT-IV:

REFRIGERATED WAREHOUSE: Factors affecting warehouse design, Building location, Design reduction. Shipping and receiving plant forms. Utility space, Controlled atmospheric storage rooms. Jacketed storages. Automated warehouse insulation, Cold storage doors.

UNIT-V:

REFRIGERATED TRUCKS, TRAILERS & CONTAINERS: Temperature control methods, Body Design & construction, Auxiliary equipment, Types of refrigeration systems. Railway refrigeration cars.

REFERENCES:

1. Refrigeration and Air-Conditioning / C. P. Arora/ Dhanpat Rai & Co.
2. Food Processing Technology: Principles and Practice / Peter Fellows / Woodhead Publishing / 3rd Edition / 2009
3. Guide and Data Book / ASHRAE.
4. Hand Book of Air-Conditioning system design/Carrier.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
I Year -I Sem. M.Tech (HV&AC)

NON-CONVENTIONAL ENERGY RESOURCES
(Elective-I)

UNIT-I:

Introduction, Energy Scenario, Survey of energy resources. Classification and need for conventional energy resources.

Solar Energy: The Sun-sun-Earth relationship, Basic matter to waste heat energy circuit, Solar Radiation, Attention, 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 -II:

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-III:

DIRECT ENERGY CONVERSION: Nuclear Fusion: Fusion, Fusion reaction, P-P cycle, Carbon cycle, Deuterium cycle, Condition for controlled fusion, Fuel cells and photovoltaic. Thermionic & thermoelectric generation, MHD generator.

Hydrogen Gas as Fuel: Production methods, Properties, I.C. Engines applications, Utilization strategy, Performances.

UNIT-IV:

BIO- ENERGY: Biomass energy sources. Plant productivity, Biomass wastes, aerobic and Anaerobic bioconversion processed, Raw metrical and properties of bio-gas, Bio-gas plant technology and status, the energetics and economics of biomass systems, Biomass gasification

UNIT-V:

WIND ENERGY: Wind, Beaufort number, Characteristics, Wind energy conversion systems, Types, Betz model. Interference factor. Power coefficient, Torque coefficient and Thrust coefficient, Lift machines and Drag machines. Matching, Electricity generation.

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.

REFERENCES:

1. Renewable Energy Resources- Basic Principles and Applications- G.N.Tiwari and M.K.Ghosal, Narosa Pub.
2. Renewable Energy Resources/ John Twidell & Tony Weir
3. Biological Energy Resources/ Malcolm Fleischer & Chris Lawis.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
I Year -I Sem. M.Tech (HV&AC)

ADVANCED THERMODYNAMICS
(Elective-I)

UNIT -I:

REVIEW OF THERMODYNAMIC LAWS AND COROLLARIES: Transient flow analysis, Second law thermodynamics, Entropy, Availability and unavailability, Thermodynamic potential. Maxwell relations, Specific heat relations, Mayer's relation. Evaluation of thermodynamic properties of working substance

UNIT-II:

P.V.T SURFACE: Equation of state. Real gas behavior, Vander Waal's equation, Generalization compressibility factor. Energy properties of real gases. Vapour pressure, Clausius, Clapeyron equation. Throttling, Joule-Thompson coefficient. Non reactive mixtures of perfect gases. Governing laws, Evaluation of properties, Psychometric mixture properties and psychometric chart, Air conditioning processes, cooling towers. Real gas mixture.

UNIT-III:

COMBUSTION: Combustion Reactions, Enthalpy of formation. Entropy of formation, Reference levels of tables. Energy of formation, Heat reaction, Adiabatic flame temperature generated product, Enthalpies, Equilibrium. Chemical equilibrium of ideal gases, Effect of non reacting gases equilibrium in multiple reactions, The van't Hoff's equation. The chemical potential and phase equilibrium. The Gibbs phase rule.

UNIT-IV:

POWER CYCLES: Review binary vapour cycle, co generation and combined cycles, Second law analysis of cycles. Refrigeration cycles. Thermodynamics of irreversible processes. Introduction, Phenomenological laws, Onsager Reciprocity relation, Applicability of the Phenomenological relations, Heat flux and entropy production, Thermodynamic phenomena, Thermo electric circuits.

UNIT-V:

DIRECT ENERGY CONVERSION INTRODUCTION: Fuel cells, Thermo electric energy, Thermo ionic power generation, Thermodynamic devices magneto hydrodynamic generations, Photovoltaic cells.

REFERENCES:

1. Basic and Applied Thermodynamics/ P.K.Nag/ TMH
2. Thermodynamics/Holman/ McGraw Hill.
3. Engg. Thermodynamics/PL.Dhar / Elsevier
4. Thermodynamics/Sonnatag & Van Wylen / John Wiley & Sons
5. Thermodynamics for Engineers/Doolittle-Messe / John Wiley & Sons
6. Irreversible thermodynamics/HR De Groff.
7. Thermal Engineering / Soman / PHI
8. Thermal Engineering / Rathore / TMH

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
I Year -I Sem. M.Tech (HV&AC)

COMPUTATIONAL FLUID DYNAMICS
(Elective-II)

UNIT - I

INTRODUCTION: Finite difference method, finite volume method, finite element method, governing equations and boundary conditions, Derivation of finite difference equations.

Solution methods: Solution methods of elliptical equations — finite difference formulations, interactive solution methods, direct method with Gaussian elimination.

Parabolic equations-explicit schemes and Von Neumann stability analysis, implicit schemes, alternating direction implicit schemes, approximate factorization, fractional step methods, direct method with tridiagonal matrix algorithm.

UNIT - II

Hyperbolic equations: explicit schemes and Von Neumann stability analysis, implicit schemes, multi step methods, nonlinear problems, second order one-dimensional wave equations.

Burgers equations: Explicit and implicit schemes, Runge-Kutta method.

UNIT - III

FORMULATIONS OF INCOMPRESSIBLE VISCOUS FLOWS: Formulations of incompressible viscous flows by finite difference methods, pressure correction methods, vortex methods.

Treatment of compressible flows: potential equation, Euler equations, Navier-stokes system of equations, flow field-dependent variation methods, boundary conditions, example problems.

UNIT - IV

FINITE VOLUME METHOD: Finite volume method via finite difference method, formulations for two and three-dimensional problems.

UNIT - V

STANDARD VARIATIONAL METHODS: Linear fluid flow problems, steady state problems, Transient problems.

REFERENCES:

1. Computational fluid dynamics/ T. J.C'hung/ Cambridge University press,2002.
2. Text book of fluid dynamics/ Frank Choriton/ CBS Publishers & distributors, 1985
3. Numerical heat transfer and fluid flow / Suhas V. Patankar/ Hema shava Publishers corporation & Mc Graw Hill.
4. Computational Fluid Flow and Heat Transfer/ Muralidaran/ Narosa Publications
5. Computational Fluid Dynamics: Basics with applications/John D. Anderson/ Mc Graw Hill.
6. Fundamentals of Computational Fluid Dynamics/Tapan K. Sengupta / Universities Press.
7. Introduction to Theoretical and Computational Fluid Dynamics/C. Pozrikidis /Oxford University Press/2nd Edition

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
I Year -I Sem. M.Tech (HV&AC)

MAINTANANCE MANAGEMENT
(Elective-II)

UNIT -I:

INTRODUCTION AND PURPOSE OF MAINTENANCE: Function of Maintenance, Maintenance systems, Classification of equipment, Planning and scheduling of maintenance work.

UNIT -II:

PREVENTIVE MAINTENANCE: Breakdown and Preventive maintenance, Condition monitoring and signature analysis.

UNIT-III: Simulation Reliability and Maintainability:

UNIT-IV: Organization for Maintenance Work: Maintenance Budget

UNIT-V: Incentive for Maintenance Work: Maintenance Budget

REFERENCES:

1. Maintenance Planning Control and Documentation/ E.N.Whiter Grower Press
2. Maintenance Management / Garg
3. Maintenance Management: Seminar Proceedings, National Productivity Council, New Delhi.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
I Year -I Sem. M.Tech (HV&AC)

MATERIAL SCIENCE
(ELECTIVE - II)

UNIT – I

ATOMIC AND IONIC ARRANGEMENTS:

Amorphous Materials : Principles and Technological Applications, Lattice, Unit cell, Basis, and Crystal Structures, Points, Directions, and Planes in the unit cell, Crystal Structures of Ionic Materials

Implementation in the Atomic and Ionic Arrangements: Point Defects, Dislocations, Significance of Dislocations, Schmid's Law, Surface defects

UNIT – II

MECHANICAL PROPERTIES: FUNDAMENTALS AND TENSILE, HARDNESS, AND IMPACT TESTING: The Tensile Test: Use of the Stress – Strain Diagram, True Stress and True Strain, The Bend Test for Brittle Materials, Hardness of Materials, Strain Rate effects and Impact Behaviour

Heat Treatment of Steels and Cast Irons: Designations and Classification of Steels, Simple Heat treatments, Isothermal Heat treatments, Quench and Temper Heat treatments, Surface treatments, Weldability of Steel.

UNIT – III

FRACTURE MECHANICS, FATIGUE, AND CREEP BEHAVIOUR

Fracture Mechanics, The Importance of Fracture Mechanics, Microstructural Features of Fracture in Metallic Materials., Microstructural Features of Fracture in Ceramics, Glasses, and Composites, Fatigue, Result of the Fatigue test, Application of Fatigue test, Creep, Stress Rupture, and Stress Corrosion, Evaluation of creep Behaviour

UNIT – IV

POLYMERS

Classifications of Polymers, Typical Thermoplastics, Structure - Property Relationship in thermoplastics, Effect of Temperature on thermoplastics, Mechanical Properties of thermoplastics, Elastomers (Rubbers), Thermosetting Polymers

Ceramic Materials: Applications of Ceramics, Properties of Ceramics, Characteristics of Sintered ceramics, Glass Ceramics, Refractories

UNIT – V

COMPOSITES: TEAMWORK AND SYNERGY IN MATERIAL

Particulate Composites, Fibre – Reinforced Composites, Characteristics of Fibre – Reinforced composites, Manufacturing Fiber and Composites, Fiber Reinforced Systems and Applications, Laminar Composite Materials, Examples and Applications of Laminar Composites.

REFERENCES:

1. High temperature materials technology /Campbell E.E. and Sherwood /John Wiley and Sons, 1967
2. High temperature technology /Campbell I.E. /John Wiley
3. High temperature materials /Hehmann R.F./Wiley and sons/1967.
4. Behaviour of high temperature alloys/Proceeding of International conference/ 1979.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
I Year -I Sem. M.Tech (HV&AC)

REFRIGERATION LAB

1. Find out ice making and COP of domestic refrigerator
2. Find out COP of Electrolux refrigerator (3 fluid system)
3. Find out the Cooling capacity and COP of the evaporative condensing unit
4. Study of the refrigeration equipments (Compressors, Condensers, evaporator, thermostat valve etc.)
5. Study of the pull down characteristics of domestic refrigerator

JNTUWORLD

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
I Year -II Sem. M.Tech (HV&AC)

ADVANCED HEAT AND MASS TRANSFER

UNIT-I:

BRIEF INTRODUCTION TO DIFFERENT MODES OF HEAT TRANSFER: Conduction: General heat Conduction equation-initial and boundary conditions.

Transient heat conduction: Lumped system analysis-Heisler charts-semi infinite solid-use of shape factors in conduction-2D transient heat conduction-product solutions.

UNIT- II:

FINITE DIFFERENCE METHODS FOR CONDUCTION: 1D & 2D steady state and simple transient heat conduction problems-implicit and explicit methods.

Forced Convection: Equations of fluid flow-concepts of continuity, momentum equations-derivation of energy equation-methods to determine heat transfer coefficient: Analytical methods-dimensional analysis and concept of exact solution. Approximate method-integral analysis.

UNIT-III:

EXTERNAL FLOWS: Flow over a flat plate: integral method for laminar heat transfer coefficient for different velocity and temperature profiles. Application of empirical relations to variation geometries for laminar and turbulent flows.

Internal flows: Fully developed flow: integral analysis for laminar heat transfer coefficient-types of flow-constant wall temperature and constant heat flux boundary conditions-hydrodynamic & thermal entry lengths; use of empirical correlations.

UNIT-IV:

FREE CONVECTION: Approximate analysis on laminar free convective heat transfer-boussinesque approximation-different geometries-combined free and forced convection.

Boiling and condensation: Boiling curve-correlations-Nusselts theory of film condensation on a vertical plate-assumptions & correlations of film condensation for different geometries.

UNIT-V:

RADIATION HEAT TRANSFER: Radiant heat exchange in grey, non-grey bodies, with transmitting. Reflecting and absorbing media, specular surfaces, gas radiation-radiation from flames.

Mass Transfer: Concepts of mass transfer-diffusion & convective mass transfer analogies-significance of non-dimensional numbers.

REFERENCES:

1. Principals of Heat Transfer/Frank Kreith/Cengage Learning
2. Elements of Heat Transfer/E. Radha Krishna/CRC Press/2012
3. Heat Transfer/RK Rajput/S.Chand
4. Introduction to Heat Transfer/SK Som/PHI
5. Engineering Heat & Mass Transfer/Mahesh Rathore/Lakshmi Publications
6. Heat Transfer / Necati Ozisik / TMH
7. Heat Transfer / Nellis & Klein / Cambridge University Press / 2012.
8. Heat Transfer/ P.S. Ghoshdastidar/ Oxford Press
9. Engg. Heat & Mass Transfer/ Sarit K. Das/Dhanpat Rai
10. Heat Transfer/ P.K.Nag /TMH

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
I Year -II Sem. M.Tech (HV&AC)

AIR CONDITIONING – II

UNIT-I :

AIR CONDITIONING SYSTEMS: All water, All air, air water system. Unitary System, window air conditioner, split and central air conditioning system, cooling load calculations - occupancy load, lighting load, appliance load, product load, difference between summer & winter load calculations.

UNIT-II :

AIR DISTRIBUTION: Room air distribution - types of supply air outlets, mechanism of flow through outlets, selection and location of outlets, general considerations. Distribution patterns of outlets - ducts- Definition and types - materials for ducts and its specification, friction loss in ducts - grills, diffusers, registers, rectangular equivalent of circular duct. Air duct designs, duct construction, duct design procedures. Equal friction method, static regain method, velocity reduction method.

UNIT-III:

THERMAL INSULATION FOR A/C SYSTEM: Method of heat transfer - desired properties of ideal insulating materials - types of insulating materials. Heat transfer through insulation - economic thickness of insulation. Insulation of heated buildings - Insulation for cooling building and cold storage - pipe insulation.

UNIT-IV:

AIR CONDITIONING APPARATUS: Fans and blowers - types of fans- fan characteristic- centrifugal fans, axial fans -- fan arrangements, filters, sources of noise and control, static pressure calculation for selection of motor and fan. Water supply pipe sizing calculations - piping network for supply and return water line - pipe fittings - lining and insulation - piping system as per ASHRAE standards

UNIT-V:

APPLICATIONS: Air conditioning systems for automobiles (cars, buses etc) - Air conditioning systems for (trains, ships, aircraft) - Special applications - Computers, hospitals, cold storages, printing, textiles and leather industries.

REFERENCES:

1. Refrigeration & Air-Conditioning by Domkundwar
2. Refrigeration & Air-Conditioning by V.K. Jain
3. Refrigeration & Air-Conditioning by C.P. Arora
4. ASHRAE Hand Book
5. Hand Book of Air Conditioning System design by Carrier

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
I Year -II Sem. M.Tech (HV&AC)

ADVANCED INSTRUMENTATION AND CONTROL SYSTEMS

UNIT-I:

VIBRATION AND ACCELERATION MEASUREMENT: Vibration and acceleration measuring instruments -linear acceleration using strain gauges, capacitive, mechanical and electronic tachometers.

UNIT-II:

PRESSURE MEASUREMENT: Resistive, magnetic, capacitive pressure transducers - Thermal conductive gauges- Mc-leod gauge, ionization gauge - pressure, measurement using strain gauges.

UNIT-III:

FLOW MEASUREMENTS: Different types of flow transducers - Magnetic flow meters - interferometer for visualization - Rotameter other conventional types of obstruction meters.

Level Indicators: Magnetic type float gauge - Oscillator type detectors-liquid and solid level measurement by variation of capacitance.

UNIT-IV:

CRYOGENIC INSTRUMENTATION: Low temperature measurements, measurement of micro-temperatures.

Measurement of Strain: Use of resistance strain gauge in measuring different mechanical input systems.

UNIT-V:

AIR-CONDITIONING CONTROLS: Introduction - Types, direct & reverse acting thermostats, with receiver controller - liquid valves, fail safe design, throttling range - dampers, outdoor air control - freeze protection - building up a control system, humidity stats and humidifiers- valve characteristics and selection.

REFERENCES:

1. Instrumentation for engineering measurement /R.H. Cerni & L.E. Foster/ wily 1982
2. Instrumentation in Scientific research/K.S, Lion/ Megravv Hill
3. Automatic process control/ D.P. Eckman /Wiley
4. Refrigeration and Air-Conditioning/W.F. Stoecker, J.W. Jone/ McGraw Hill 1982

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
I Year -II Sem. M.Tech (HV&AC)

REFRIGERATION & AIR-CONDITIONING EQUIPMENTS AND CONTROLS

UNIT-I :

COMPRESSORS-TYPES : constructional details of reciprocating compressors - volumetric efficiency-factors affecting volumetric efficiency-effects of evaporator and condenser pressures- centrifugal compressor - constructional details, applications : Comparison with reciprocating compressors - screw compressors, working principle, single screw and double screw compressor, lubricating oils-rotary compressor-single vane and multivane compressor surging.

UNIT-II:

CONDENSERS: types-water cooled & air cooled condensers-evaporative type, thermal design of compressor-temperature distribution and heat flow in a condenser, pressure drop, fouling factor-LMTD correction factor. (No problems)

Cooling Towers: Classification-performance of cooling towers-analysis of counter flow cooling towers-enthalpy-temperature diagram of air and water.

Cooling ponds: types-cross flow cooling towers-procedure for calibration of outlet conditions.

UNIT-III:

EVAPORATORS: types-flooded & dry evaporators-natural & forced convection type-shell & tube, shell & coil, plate type-secondary evaporators-temperature distribution and heat flow in evaporators-pressure drop, fouling correction factor, (no problems)

UNIT-IV:

EXPANSION DEVICES - Capillary tube, thermostatic expansion valve, float valve, automatic expansion valve, solenoid control valve— pipe design-general-water piping, refrigerant piping & steam piping-water treatment-corrosion control, scale formation control.

UNIT-V:

INSTALLATION OF VAPOR COMPRESSION REFRIGERATION SYSTEM: evaluation & dehydration-testing for leakages-charging-adding oil defrosting-methods-material, automatic, periodic defrosting-solid & liquid adsorbents; water defrosting - defrosting by reversing the cycle, automatic hot gas defrosting-thermo balance defrosting, electric control defrosting (no problems)

REFERENCES:

1. Refrigeration & Air-Conditioning / Stoecker/ TMGH 1982
2. Refrigeration & Air-Conditioning / Domkundwar/Danapathi Rai
3. Refrigeration & Air-Conditioning / C.P. Arora/
4. ASHRAE guide & data book application

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
I Year -II Sem. M.Tech (HV&AC)

ENERGY MANAGEMENT
(Elective-III)

UNIT-I

INTRODUCTION: Principles of energy management. Managerial organization, Functional areas for i) manufacturing industry, ii) Process industry, iii) Commerce, iv) Government, Role of Energy manager in each of these organizations. Initiating, Organizing and managing energy management programs

UNIT -II

ENERGY AUDIT: Definition and concepts. Types of energy audits, Basic energy concepts, Resources for plant energy studies. Data gathering, Analytical techniques. Energy Conservation: Technologies for energy conservation, Design for conservation of energy materials, Energy flow networks. Critical assessment of energy usage. Formulation of objectives and constrains, Synthesis of alternative options and technical analysis of options. Process integration.

UNIT-III

ECONOMIC ANALYSIS: Scope, Characterization of an investment project. Types of depreciation, Time value of money. Budget considerations, Risk analysis.

UNIT-IV

METHODS OF EVALUATION OF PROJECTS: Payback, Annualized costs, Investor's rate of return, Present worth, Internal rate of return, Pros and cons of the common method of analysis, Replacement analysis.

UNIT-V

ALTERNATIVE ENERGY SOURCES: SOLAR ENERGY: Types of devices for solar energy collections, Thermal storage system, Control systems. Wind Energy, Availability, Wind Devices, Wind Characteristics, performance of turbines and systems.

REFERENCES:

1. Energy Management Hand Book / W.C. Turner (Ed)
2. Energy Management Principles / CB Smith/ Pergamon Press
3. Energy Management / W.R.Murthy and G.Mc.Kay / BS Publication
4. Management / H.Koontz and Cyrill Donnel / McGraw Hill
5. Financial Management / S.C.Kuchhal / Chaitanya Publishing House

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
I Year -II Sem. M.Tech (HV&AC)

EQUIPMENT DESIGN FOR THERMAL SYSTEMS
(Elective-III)

UNIT -I:

CLASSIFICATION OF HEAT EXCHANGERS: Introduction, Recuperation & regeneration, Tabular 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 Tabular 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-II:

DOUBLE PIPE HEAT EXCHANGER: Film coefficient for fluids in annulus, fouling factors, Calorific temperature, Average fluid temperature, The calculation of double pipe exchanger, Double pipe exchangers in series parallel arrangements.

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 of shell & tube heat exchangers, Flow arrangements for increased heat recovery, the calculation of 2-4 exchangers.

UNIT-III:

CONDENSATION OF SINGLE VAPOURS: Calculation of horizontal condenser, Vertical condenser, De-Super heater condenser, Vertical condenser-sub-Cooler, Horizontal Condenser-Sub cooler, Vertical reflux type condenser. Condensation of steam.

UNIT-IV:

VAPORIZERS, EVAPORATORS AND REBOILERS: Vaporizing processes, Forced circulation vaporizing exchanger, Natural circulation vaporizing exchangers, Calculations of a reboiler. Extended Surfaces: Longitudinal fins. Weighted fin efficiency curve, Calculation of a Double pipe fin efficiency curve. Calculation of a double pipe finned exchanger, Calculation of a longitudinal fin shell and tube exchanger.

UNIT-V:

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.

REFERENCES:

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

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
I Year -II Sem. M.Tech (HV&AC)

ADVANCED FINITE ELEMENT ANALYSIS
(Elective-III)

UNIT-I:

Introduction to FEM, basic concepts, historical back ground, applications of FEM, general description, comparison of FEM with other methods, variational approach, Galerkin's Methods. Co-ordinates, basic element shapes, interpolation function, Virtual energy principle, Rayleigh – Ritz method, properties of stiffness matrix, treatment of boundary conditions, solution of system of equations, shape functions and characteristics, Basic equations of elasticity, strain-displacement relations.

UNIT-II:

1-D STRUCTURAL PROBLEMS: Axial bar element – stiffness matrix, load vector, temperature effects, Quadratic shape functions and problems.

ANALYSIS OF TRUSSES : Plane Trusses and Space Truss elements and problems

ANALYSIS OF BEAMS : Hermite shape functions – stiffness matrix – Load vector – Problems.

UNIT-III:

2-D PROBLEMS: CST, LST, force terms, Stiffness matrix and load vectors, boundary conditions, Isoparametric elements – quadrilateral element, shape functions – Numerical Integration.

Finite element modeling of Axi-symmetric solids subjected to Axi-symmetric loading with triangular elements.

3-D PROBLEMS: Tetrahedran element – Jacobian matrix – Stiffness matrix.

UNIT-VI:

SCALAR FIELD PROBLEMS: 1-D Heat conduction-Slabs – fins - 2-D heat conduction problems – Introduction to Torsional problems.

UNIT-V:

Dynamic considerations, Dynamic equations – consistent mass matrix – Eigen Values, Eigen vector, natural frequencies – mode shapes – modal analysis.

REFERENCES:

1. The Finite Element Methods in Engineering / SS Rao / Pergamon.
2. Finite Element Methods: Basic Concepts and applications, Alavala, PHI
3. Introduction to Finite Elements in Engineering, Chandrupatla, Ashok and Belegundu, Prentice – Hall
4. Finite Element Method – Zincowitz / Mc Graw Hill
5. Introduction to Finite element analysis- S.Md.Jalaludeen, Anuradha Publications, print-2012
6. A First Course in the Finite Element Method/Daryl L Logan/Cengage Learning/5th Edition
7. Finite Element Method – Krishna Murthy / TMH
8. Finite Element Analysis – Bathe / PHI

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
I Year -II Sem. M.Tech (HV&AC)

THERMAL AND NUCLEAR POWERPLANTS
(Elective-IV)

UNIT -I:

INTRODUCTION: Sources of energy, Type of Power plants. Direct energy conversion system, Energy sources in India, Recent developments in power generation, Combustion of coal, Volumetric analysis, Gravimetric analysis. Fuel gas analysis.

Steam power plant: Introduction. General layout of steam power plant, Modern coal. Fired Steam, Steam power plant. Power plant cycle, Fuel Handling, Combustion equipment, Ash handling, Dust collectors.

Steam Generators: Types, Accessories. Feed water heaters, Performance of boiling, Water treatment, Cooling towers. Steam turbines. Compounding of turbines, Steam condensers, Jet and surface condensers.

UNIT-II:

GAS TURBINE POWER PLANT: Cogeneration. Combined cycle power plant, Analysis, Waste heat recovery, IGCC power plant, Fluidized bed, Combustion, Advantages, Disadvantages

UNIT-III:

NUCLEAR POWER PLANT: Nuclear physics, Nuclear Reactor, Classification, Types of reactors, Site selection. Method of enriching uranium. Application of nuclear power plant. Nuclear Power Plant Safety: Bi-Product of nuclear power generation, Economics of nuclear power plant, Nuclear power plant in India, Future of nuclear power.

UNIT-IV:

ECONOMICS OF POWER GENERATION: Factors affecting the economics, Loading factors, Utilization factor, Performance and operating characteristics of power plant, Point economic load sharing, Depreciation. Energy rate, Criteria for optimum loading. Specific economic energy problem

UNIT-V:

POWER PLANT INSTRUMENTATIONS: Classification, Pressure measuring instrument, Temperature measurement and Flow Measurement, Analysis of combustion gases, Pollution types, Methods of control.

REFERENCES:

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

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
I Year -II Sem. M.Tech (HV&AC)

CRYOGENIC ENGINEERING
(Elective-IV)

UNIT -I:

INTRODUCTION TO CRYOGENIC SYSTEMS: Mechanical Properties at low temperatures. Properties of Cryogenic Fluids.

Gas Liquefaction: Minimum work for liquefaction. Methods to protect low temperature. Liquefaction systems for gases other than Neon. Hydrogen and Helium.

UNIT II:

LIQUEFACTION SYSTEMS FOR NEON, HYDROGEN AND HELIUM: Components of Liquefaction systems. Heat exchangers. Compressors and expanders. Expansion valve, Losses in real machines.

UNIT-III:

GAS SEPARATION AND PURIFICATION SYSTEMS: Properties of mixtures, Principles of mixtures, Principles of gas separation, Air separation systems.

UNIT-IV:

CRYOGENIC REFRIGERATION SYSTEMS: Working Medium, Solids, Liquids, Gases, Cryogenic fluid storage & transfer, Cryogenic storage systems, Insulation, Fluid transfer mechanisms, Cryostat, Cryo Coolers

UNIT-V:

APPLICATIONS: Space technology, In-Flight air separation and collection of LOX, Gas industry, Biology, Medicine, Electronics.

REFERENCES:

1. Cryogenic Systems/ R.F.Barren/ Oxford University Press
2. Cryogenic Research and Applications: Marshal Sitting/ Von Nostrand/ Inc. New Jersey
3. Cryogenic Heat Transfer/ R.F.Baron
4. Cryogenic Engineering Edit / B.A. Hands/ Academic Press, 1986
5. Cryogenic Engineering/ R.B.Scottm Vin Nostrand/ Inc. New Jersey, 1959
6. Experimental Techniques in Low Temperature Physics- O.K. White, Oxford Press, 1968
7. Cryogenic Process Engineering/ K.D. Timmerhaus & TM Flynn/ Plenum Press, 1998

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
I Year -II Sem. M.Tech (HV&AC)

TURBO MACHINES
(Elective-IV)

UNIT-I:

FUNDAMENTALS OF TURBO MACHINES: Classifications, Applications, Thermodynamic analysis, Isentropic flow. Energy transfer. Efficiencies, Static and Stagnation conditions, Continuity equations, Euler's flow through variable cross sectional areas, Unsteady flow in turbo machines

UNIT -II:

STEAM NOZZLES: Convergent and Convergent-Divergent nozzles, Energy Balance, Effect of back pressure of analysis. Designs of nozzles.

Steam Turbines: Impulse turbines, Compounding, Work done and Velocity triangle, Efficiencies, Constant reactions, Blading, Design of blade passages, Angle and height, Secondary flow. Leakage losses, Thermodynamic analysis of steam turbines.

UNIT-III:

GAS DYNAMICS: Fundamental thermodynamic concepts, isentropic conditions, mach numbers and area, Velocity relations, Dynamic Pressure, Normal shock relation for perfect gas. Super sonic flow, oblique shock waves. Normal shock recoveries, Detached shocks, Aerofoil theory.

Centrifugal compressor: Types, Velocity triangles and efficiencies, Blade passage design, Diffuser and pressure recovery. Slip factor, Stanitz and Stodola's formula's, Effect of inlet mach numbers, Pre whirl, Performance

UNIT-IV:

AXIAL FLOW COMPRESSORS: Flow Analysis, Work and velocity triangles, Efficiencies, Thermodynamic analysis. Stage pressure rise, Degree of reaction, Stage Loading, General design, Effect of velocity, Incidence, Performance

Cascade Analysis: Geometrical and terminology. Blade force, Efficiencies, Losses, Free end force, Vortex Blades.

UNIT-V:

AXIAL FLOW GAS TURBINES: Work done. Velocity triangle and efficiencies, Thermodynamic flow analysis, Degree of reaction, Zweifel's relation, Design cascade analysis, Soderberg, Hawthorne, Ainley, Correlations, Secondary flow, Free vortex blade, Blade angles for variable degree of reaction. Actuator disc, Theory, Stress in blades, Blade assembling, Material and cooling of blades, Performances, Matching of compressors and turbines, Off design performance

REFERENCES:

1. Fundamentals of Turbo Machines/Shepherd /
2. Element of Gas Dynamics/Yahya
3. Turbines, Pumps, Compressors/Yahya
4. Practice on Turbo Machines/ G.Gopal Krishnan & D.Prithviraj/ Sci Tech Publishers, Chennai
5. Theory and practice of Steam Turbines/ Kearton
6. Gas Turbines Theory and Practice/Zucrow
7. Element of Gas Dynamics/Liepeman and Roshkow/ Dover Publications.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
I Year -II Sem. M.Tech (HV&AC)

AIR CONDITIONING LAB

1. Find out the COP and Cooling Capacity of window Air Conditioning System
2. Find out the efficiency of air washer test rig
3. Find out the Humidified efficiency and overall efficiency of the experimental Cooling tower
4. Find the COP, Cooling Capacity and bypass factor of the Air Condition test rig
5. COP of miniature centralized AC unit
6. Simple Cooling and heating load calculations using related software

JNTUWORLD