

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M.TECH. (HEATING, VENTILATION & AIR-CONDITIONING)

EFFECTIVE FROM ACADEMIC YEAR 2019- 20 ADMITTED BATCH

R19 COURSE STRUCTURE AND SYLLABUS

I Year I Semester

Course Code	Course Title	L	T	P	Credits
Professional Core - I	Refrigeration	3	0	0	3
Professional Core - II	Air-Conditioning	3	0	0	3
Professional Elective-I	1. Advanced Thermodynamics 2. Equipment Design for Thermal Systems 3. Advanced Thermal Storage Technologies	3	0	0	3
Professional Elective-II	1. Advanced Heat Transfer 2. Conduction and Radiation Heat Transfer 3. Convective Heat and Mass Transfer	3	0	0	3
MC	Research Methodology and IPR	2	0	0	2
Lab - I	Refrigeration Lab	0	0	4	2
Lab - II	Air-Conditioning Lab	0	0	4	2
Audit - I	Audit Course - I	2	0	0	0
	Total Credits	16	0	8	18

I Year II Semester

Course Code	Course Title	L	T	P	Credits
Professional Core- III	Ventilation Systems	3	0	0	3
Professional Core- IV	Heating Systems	3	0	0	3
Professional Elective-III	1. Design for Air-Conditioning Systems 2. HVAC Design Systems 3. Ducting & Air-Conditioning Supply Systems	3	0	0	3
Professional Elective- IV	1. Computational Fluid Dynamics 2. Advanced Fluid Mechanics 3. Cryogenic Engineering	3	0	0	3
	Mini Project with Seminar	0	0	4	2
Lab - III	Ventilation Simulation Lab	0	0	4	2
Lab - IV	Heating Simulation Lab	0	0	4	2
Audit - II	Audit Course - II	2	0	0	0
	Total Credits	14	0	12	18

Audit Course I & II:

1. English for Research Paper Writing
2. Disaster Management
3. Sanskrit for Technical Knowledge
4. Value Education
5. Constitution of India
6. Pedagogy Studies
7. Stress Management by Yoga
8. Personality Development through Life Enlightenment Skills

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I Year I Sem. (HVAC)

REFRIGERATION (Professional Core - I)

Course Objectives:

- To understand the principles of refrigeration.
- To understand different vapor Absorption systems.
- To know Aircraft Air refrigeration systems.
- To gain knowledge about refrigerants.
- Ozone depletion potential and global warming potential.

Course Outcomes: On successful completion of the course, the student will be able to,

- Illustrate the basic concepts of refrigeration system.
- Analyze the vapour compression cycle and interpret the usage of refrigerants.
- Explain the components of vapour absorption system.
- Demonstrate the use of refrigerants.
- Discuss the theory Ozone depletion potential and global warming potential.

UNIT-I:

Vapor Compression Refrigeration: Analysis of vapor compression refrigeration cycle - reversed Carnot cycle for vapour - effect of suction temperature and condensing temperature on cycle performance – Practical refrigeration cycle – sub-cooled liquid and super heated vapor refrigeration cycles their effect on performance. Multi Pressure Systems- removal of flash gas- intercooling –compound compression (conversion)-multi vapor systems- cascade systems- dual compression- system practices.

UNIT-II:

Simple vapor Absorption systems- actual vapor absorption cycle- representation of the cycle on H-C diagram- common refrigerant- (Absorbent) Adsorbent systems. Practical single effect Water- Lithium Bromide Absorption system- double effect system- Electrolux refrigerator- newer mixtures for absorption systems.

UNIT-III:

Aircraft Air refrigeration – Functions – working conditions – types. Steam jet water vapor systems- thermoelectric refrigeration systems - vortex refrigeration system - pulse tube refrigeration.

UNIT-IV:

Refrigerants: Desirable properties- thermo dynamic-chemical and transport properties - designation of refrigerants - inorganic, halo carbon refrigerants - secondary refrigerants - Properties of mixtures of refrigerants

UNIT-V:

Ozone depletion potential and global warming potential – effect of refrigerants- alternative refrigerants- newer refrigerants.

REFERENCE BOOKS:

1. R & A/C by F. Stoecker & Jerold. W. Jones- MGH Intl., 1982.
2. R & A/C by C.P. Arora, TMGH-2000.
3. R & A/C by Manohar Prasad.
4. Principles of Refrigeration by Roy.J.Dossat, 1997.
5. Refrigeration by Gosney- Oxford University Press-1980.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I Year I Sem. (HVAC)

AIR-CONDITIONING (Professional Core - II)

Course Objectives:

- Will understand well, the importance of maintaining the thermal environment for human comfort which ultimately enhances the working efficiency.
- Will be in a position to understand the necessity of maintaining the temperature and humidity for various processes in process and pharmaceutical industries.
- Will become fully aware of the techniques for controlling the contamination of environment which is a must for modern A C systems.

Course Outcomes:

- Define the need and importance of HVAC, handling of different HVAC systems.
- Describe thermal comfort, its principles and practices, clothing and activities and their impact on comfort and productivity
- Interpret ventilation impact on human comfort, productivity and health.
- Propose psychrometry application to HVAC engineering and design different HVAC systems.
- Explain air and water/refrigerant flow in ducts and pipes, duct and piping design, air distribution in rooms.
- Paraphrase control of HVAC systems- automatic and manual, different control systems used.

UNIT-I:

Psychrometry: Properties of Moist air- Psychrometric relations - Psychrometric chart - Psychrometric processes in air-conditioning equipment - Bypass factor - Sensible heat factor

Applied Psychrometry: Effective and grand sensible heat factors- Selection of Air- Conditioning apparatus for cooling and dehumidification-High latent cooling load applications- All outdoor air application.

UNIT-II:

Air-conditioning Processes –Mixing process- Summer, Winter and Year-round air conditioning systems - hot and dry out door condition, Hot and humid outdoor condition - winter air conditioning system - year round air-conditioning system.

UNIT-III:

Process of Cooling, Heating and Dehumidifying coils - air washers - Cooling by dry and wet coils - use of hygroscopic solution in air washers - Adiabatic dehumidifier – Humidifier-water injection - steam injection. Heat pump - Different heat pump circuits air, ground water, earth - The linked air cycle heat pump - solar energy collections - Drying of materials.

UNIT-IV:

Requirements of Comfort Air-conditions - Thermodynamics of human body - Body regulation process against heat or cold - comfort and comfort chart - Effective temperature - Factors governing optimum effective temperature -Design considerations- Selection of outside and Inside design conditions.

UNIT-V:

Ventilation systems: Natural ventilation system - Mechanical - Extraction system - Supply system - Combined supply and extraction system - Air-cleaning - Equipment used for odour suppression and air sterilization. Air-conditioning controls systems - basic elements of the control systems - temperature, humidity and pressure controls and refrigeration flow controls - room thermostat.

TEXT BOOKS:

1. Hand Book of Air conditioning system design -Carrier
2. Refrigeration & Air-conditioning -C.P.ARORA, TMGH, 2000.

REFERENCE BOOKS:

1. Refrigeration & Air-conditioning -Domkundwar and Arora, DanpatRai& Sons, 2000.
2. Refrigeration & Air-conditioning -Stoecker.
3. Refrigeration & Air-conditioning -V.K.Jain.
4. ASHRE - Guide and data book

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I Year I Sem. (HVAC)

ADVANCED THERMODYNAMICS (Professional Elective - I)

Prerequisites: Thermodynamics

Course Objectives: The course is intended to

- Provide analytical methods for the determination of the direction of processes from the first and second laws of thermodynamics and to introduce methods in using equations of potentials, availability, and exergy for thermodynamic analysis.
- Gain the knowledge on non-reactive mixture properties, Psychometric Mixture properties and psychometric chart and Air conditioning processes.
- Develop the ability of analyzing vapor and Gas power cycles.
- Provide in depth knowledge of Direct Energy Conversion of Fuel Cells, Thermo electric energy, Thermionic power generation, Thermodynamic devices Magneto Hydrodynamic Generations and Photo voltaic cells.
- Develop communication and teamwork skills in the collaborative course project

Course Outcomes: At the end of the course, the student will be able to:

- Explain basic thermodynamic concepts and laws
- Describe the concepts entropy and exergy and their use in analyses of thermal energy systems
- Analyze power plants, refrigeration plants and thermal/chemical installations
- Evaluate means for minimizing exergy losses in selected processes
- Use advanced thermodynamics on a research case

UNIT -I:

REVIEW OF THERMODYNAMIC LAWS AND COROLLARIES: Transient flow analysis, Second law of 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.

TEXT BOOKS:

1. Basic and Applied Thermodynamics by P.K.Nag, TMH
2. Engineering Thermodynamics by Rogers & Mayhew, Pearson
3. Thermodynamics by Holman, Mc Graw Hill.

REFERENCE BOOKS:

1. Thermal Engineering by Rathore, TMH
2. Applied Thermodynamics by R.K. Rajput, Laxmi Publications
3. Thermal Engineering by Soman, PHI
4. Engineering Thermodynamics by P.L.Dhar, Elsevier
5. Thermodynamics by Sonntag & Van Wylen, John Wiley & Sons
6. Thermodynamics for Engineers by Doolittle-Messe, John Wiley & Sons
7. Irreversible Thermodynamics by HR De Groff.
8. Thermodynamics & Heat Power by Granet & Bluestein, CRC Press
9. Engineering Thermodynamics by Chatopadyaya.

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I Year I Sem. (HVAC)

EQUIPMENT DESIGN FOR THERMAL SYSTEMS (Professional Elective - I)

Prerequisites: Advanced Heat and Mass Transfer

Course Objective: The course is intended to

- Design and analyze the heat exchangers parallel flow, counter flow, multipass and, cross flow heat exchanger
- Design and analyze the Shell and tube heat exchanger
- Enable to carryout the performance of heat exchanger with the extended surfaces.
- Design and analyze the cooling towers.

Course Outcomes: At the end of the course, the student will be able to:

- Understand the physics and the mathematical treatment of typical heat exchangers.
- Apply LMTD and Effectiveness methods in the design of heat exchangers and analyze the importance of LMTD approach over AMTD approach.
- Analyze the performance of double-pipe counter flow (hair-pin) heat exchangers.
- Design and analyze the shell and tube heat exchanger.
- Understand the fundamental, physical and mathematical aspects of boiling and condensation.
- Classify cooling towers and explain their technical features.

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 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-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 Exchangers: Cooling towers, relation between wet bulb & dew bulb temperatures, calculation of cooling tower performance.

Heat Pipe: Gravity assisted thermo-syphons, micro heat pipes, pulsating heat pipes, loop heat pipe operation & working principles.

TEXT BOOKS:

1. Process Heat Transfer by D.Q.Kern, TMH
2. Heat Exchanger Design by A.P.Fraas and M.N.Ozisick, John Wiley & sons, New York.

REFERENCE BOOKS:

1. Cooling Towers by J.D.Gurney and I.A. Cotter, Maclaren
2. Heat Pipe Science & Technology, Amir Faghri, Taylor & Francis
3. Heat Pipe Technology and Applications by J.P Peterson, John Wiley & sons.

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I Year I Sem. (HVAC)

ADVANCED THERMAL STORAGE TECHNOLOGIES (Professional Elective - I)

Course Objectives:

- To Understand the Necessity of Thermal Storage – Types-Energy Storage Devices.
- To Understand Sensible Heat Storage System.
- To Know Parallel Flow and Counter Flow Regenerators.
- To Gain Knowledge about Specific Areas of Application of Energy Storage.
- Latent Heat Storage Systems.

Course Outcomes:

- To be able to state the types-energy storage devices – comparison of energy storage technologies.
- To be able to identify and describe Basic concepts and modeling of heat storage units - modeling of simple water and rock bed storage system.
- To be able to explain at a level understandable by a non-technical person how various Parallel flow and counter flow regenerators.
- To be able to calculate modeling of phase change problems.
- To be able to explain green house heating – power plant applications – drying and heating for process industries.

UNIT I:

Introduction: Necessity of thermal storage – types-energy storage devices – comparison of energy storage technologies - seasonal thermal energy storage - storage materials.

UNIT II:

Sensible Heat Storage System: Basic concepts and modeling of heat storage units - modeling of simple water and rock bed storage system – use of TRNSYS – pressurized water storage system for power plant applications – packed beds.

UNIT III:

Regenerators: Parallel flow and counter flow regenerators – finite conductivity model – non – linear model – transient performance – step changes in inlet gas temperature – step changes in gas flow rate – parameterization of transient response – heat storage exchangers.

UNIT IV:

Latent Heat Storage Systems: Modeling of phase change problems – temperature based model - enthalpy model - porous medium approach - conduction dominated phase change – convection dominated phase change.

UNIT V:

Applications: Specific areas of application of energy storage – food preservation – waste heat recovery – solar energy storage – green house heating – power plant applications – drying and heating for process industries.

TEXT BOOK:

1. Ibrahim Dincer and Mark A. Rosen, Thermal Energy Storage Systems and Applications, John Wiley & Sons 2002.

REFERENCE BOOKS:

1. Schmidt. F. W and Willmott. A.J, Thermal Storage and Regeneration, Hemisphere Publishing Corporation, 1981.
2. Lunardini. V. J, Heat Transfer in Cold Climates, John Wiley and Sons 1981.

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I Year I Sem. (HVAC)

ADVANCED HEAT TRANSFER (Professional Elective - II)

UNIT- I:

Brief Introduction to Different Modes of Heat Transfer: Conduction: General heat Conduction equation-initial and boundary conditions.

1D Steady State Heat Conduction – Composite Systems – Systems with Heat Generation –Fins

2D Steady State Heat Conduction – Analytical solution for simple boundary conditions – Product Solution -use of shape factors in conduction

UNIT- II:

Transient heat conduction: Lumped system analysis-1D Transient Heat Conduction - Heisler charts-semi-infinite solid-. Finite Solids: Product solution

Finite Difference Methods for Conduction: 1D & 2D steady state and simple transient heat conduction problems-implicit and explicit methods.

UNIT- III:

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

External Flows: Flow over a flat plate: integral method for laminar flow over a flat plate for different velocity and temperature profiles. Application of empirical relations to variation geometries for laminar and turbulent flows.

UNIT- IV:

Internal flows: Types of flow-constant wall temperature and constant heat flux boundary conditions-hydrodynamic & thermal entry lengths; use of empirical correlations.

Free Convection: Approximate analysis on laminar free convective heat transfer-Boussinesque approximation-different geometries-combined free and forced convection.

UNIT-V: Boiling and condensation: Boiling curve-correlations for different regimes -- Condensation : Film and Drop wise condensation - Nusselts theory of film condensation on a vertical plate - assumptions & correlations of film condensation for different geometries.

Radiation Heat Transfer: Radiant heat exchange in grey, non-grey bodies, with transmitting. Reflecting and absorbing media, specular surfaces.

REFERENCE BOOKS:

1. Heat Transfer - A basic approach- Necati Ozisik -TMH
2. Fundamentals of Heat & Mass transfer- Incropera, Dewitt, Bergman, Lavime - wiley Publication
3. Heat Transfer/ P.S. Ghoshdastidar/ Oxford Press
4. Heat Transfer-S.P. Sukhatme- Univeristies Press
5. Fundamentals of Engineering Heat Transfer-R.C. Sachdeva-New age Science.
6. Heat Transfer/ P.K. Nag /TMH
7. Engg. Heat & Mass Transfer/ Sarit K. Das/Dhanpat Rai
8. Introduction to Heat Transfer/SK Som/PHI
9. Principals of Heat Transfer/Frank Kreith/Cengage Learning

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I Year I Sem. (HVAC)

CONDUCTION AND RADIATION HEAT TRANSFER (Professional Elective - II)

Course Objectives:

- To understand three modes of heat transfer.
- To understand Conduction through spherical shells.
- To know Heating and cooling of bodies with negligible internal resistance.
- To gain knowledge about thermal radiation.
- To understand Radiation network for an absorbing and transmitting medium.

Course Outcomes:

- Determine these resistances for conduction, radiation, and convection heat transfer, using the fundamental relationships and correlations.
- Learn to solve problems using solvers (multimode systems and design parameter sweep)
- Compare the various resistances, along with thermal energy conversion and storage, in the thermal systems and identifying the dominant resistance.
- Learn to design modern, innovative thermal systems for various applications

CONDUCTION

UNIT-I:

Introduction of three modes of heat transfer, steady, unsteady state heat transfer process, governing equations and boundary conditions

Two dimensional steady state conduction, semi-infinite and finite flat plate; temperature field in infinite and finite cylinders.

UNIT-II:

Conduction through spherical shells, numerical methods, relaxation method and finite difference methods - simple problems.

UNIT-III:

Heating and cooling of bodies with negligible internal resistance, sudden changes in the surface temperature of infinite plates, cylinders and semi-infinite bodies-simple problems.

RADIATION

UNIT-IV:

Review of the thermal radiation - gas radiation, mean beam length exchange between gas volume and black enclosure, heat exchange between gas volume and gray enclosure, problems.

UNIT-V:

Radiation network for an absorbing and transmitting medium, radiation exchange with specular surfaces, radiation exchange with transmissivity and reflecting absorbing medium. Formulation for numerical solution.

Solar radiation: Radiation properties of environment, effect of radiation on temperature measurement, the radiation heat transfer coefficient, problems.

REFERENCE BOOKS:

1. Heat Transfer -Gibhart - Mc. Graw Hill.
2. Conduction Heat Transfer- -Schneder Addition Wieselthy
3. Conduction of Heat in Solids -Carslaw & Jaeger.

4. Heat transfer -J.P. Holman, International student edition
5. Fundamentals of heat and mass transfer -R.C. Sachdev New Age International Publication
6. Heat Transfer by R. K. Rajput

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I Year I Sem. (HVAC)
CONVECTIVE HEAT AND MASS TRANSFER (Professional Elective - II)

Course Objectives:

- Understand the convective heat transfer.
- Ability to forced convection heat transfer in laminar tube flow.
- To understand boiling and condensation.
- To understand mass transfer.
- To familiarize Convective mass transfer - governing equations.

Course Outcomes

- Understand the hydrodynamic, thermal boundary layer concept and the relationship between fluid friction and heat transfer.
- Understand the concept and mechanism of forced and natural convection.
- Understand the mass transfer theories.
- Ability to apply the various empirical correlations used in different fluid flow situations.
- Ability to analyze and solve complex heat transfer phenomenon.
- Ability to design the heat exchangers for various industrial applications.

CONVECTIVE HEAT TRANSFER**UNIT-I:**

Introduction to convection, review of conservation equations - Forced convection in laminar flow - Exact and approximate solutions of Boundary layer energy equation for plane isothermal plate in longitudinal flow - problems.

UNIT-II:

Forced convection heat transfer in laminar tube flow - forced convection in turbulent flow – Internal Flows-Correlations-Problems. Approximate analysis of laminar free convective heat transfer on a vertical plate-external flows-correlations-problems.

UNIT-III:

Boiling and condensation: Analysis of film condensation on a vertical surface – pool boiling - forced convection boiling inside tubes - problems.

MASS TRANSFER**UNIT-IV:**

Definitions of concentration and velocities relevant to mass transfer, Fick's law, species conservation equation in different forms. Steady state diffusion in dilute solutions in stationary media, transient diffusion in dilute solutions in stationary media, one dimensional non dilute diffusion in gases with one component stationary.

UNIT-V:

Convective mass transfer - governing equations-forced diffusion from flat plate- Dimension less correlation's for mass transfer. Simultaneous heat and mass transfer - analogy between heat, mass and momentum transfer.

REFERENCE BOOKS:

1. Heat transfer - J. P. Holman.
2. Heat and Mass transfer- R.C. Sachdeva
3. Convective Heat and Mass transfer-Kays.
4. Heat and Mass transfer - V.Gupta and I.Srinivasan - Tata Mc.Graw Hill

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I Year I Sem. (HVAC)

RESEARCH METHODOLOGY AND IPR

Prerequisite: None

Course Objectives:

- To understand the research problem
- To know the literature studies, plagiarism and ethics
- To get the knowledge about technical writing
- To analyze the nature of intellectual property rights and new developments
- To know the patent rights

Course Outcomes: At the end of this course, students will be able to

- Understand research problem formulation.
- Analyze research related information
- Follow research ethics
- Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasize the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
- Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

UNIT-I:

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT-II:

Effective literature studies approaches, analysis, Plagiarism, Research ethics

UNIT-III:

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT-IV:

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT-V:

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

TEXT BOOKS:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"

REFERENCES:

1. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
2. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
3. Mayall, "Industrial Design", McGraw Hill, 1992.
4. Niebel, "Product Design", McGraw Hill, 1974.
5. Asimov, "Introduction to Design", Prentice Hall, 1962.
6. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016.
7. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I Year I Sem. (HVAC)

REFRIGERATION LAB (Lab - I)

Course Objectives:

- To make student understand working of various machines related to refrigeration and their energy efficiency related performance.
- To explain student working of various components of refrigeration systems.

Course Outcomes:

- Analyze the performance Domestic Vapor Compression Refrigeration system.
- Evaluate the performance of the Vapor compression and Air conditioning units.
- Analyze the Expansion devices.
- Evaluate the performance of capacity and cop. of evaporative condensing test rig.

List of Experiments:

1. Find out the Cop. and time taken for ICE making in the Domestic Vapor Compression Refrigeration.
2. Study on Compressor unit.
3. Find out the pull-down characteristics of V.C.R.S.
4. Study of Condenser unit
5. Find our the c.o.p. of vapor Absorption Refrigeration system
6. Study on Expansion devices.
7. Find our the cooling capacity and cop. of evaporative condensing test rig.
8. Study on Evaporating device.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I Year I Sem. (HVAC)

AIR-CONDITIONING LAB (Lab - II)

Course Objectives:

- To understand Humidification and Dehumidification process.
- To understand Gas charging unit.
- To know various process and by-pass factor by using Air conditioning test Rig.
- To gain knowledge on Air-condition system. Split – Air conditioning system and Central Air conditioning system.
- To understand over-all efficiency of cooling Tower.

Course Outcomes:

- Ability to apply the theoretical knowledge to solve problems in Heat Power Engineering.
- Hands on experience through actual experimentation or simulation.
- Ability to formulate and analyze practical problems.
- Ability to prepare mathematical/geometrical model and solve it using appropriate software.
- Ability to analyze data obtained through experimentation/simulation and drawing suitable technical conclusion.
- Ability to prepare technical report for the given case study.

List of Experiments:

1. Study the Humidification and Dehumidification process.
2. Find out the Efficiency of the Air-washer test rig.
3. Study on Gas charging unit
4. Find out over-all efficiency of cooling Tower.
5. Find out the capacity and by-pass factor of the window air conditioning.
6. Study the various process and by-pass factor by using Air conditioning test Rig.
7. Study on Heat pump
8. Study on Air-condition system. Split – Air conditioning system and Central Air conditioning system.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech. (HVAC)

ENGLISH FOR RESEARCH PAPER WRITING (Audit Course - I & II)

Prerequisite: None

Course objectives: Students will be able to:

- Understand that how to improve your writing skills and level of readability
- Learn about what to write in each section
- Understand the skills needed when writing a Title Ensure the good quality of paper at very first-time submission

UNIT-I:

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT-II:

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

UNIT-III:

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

UNIT-IV:

key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,

UNIT-V:

skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions. useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

TEXT BOOKS/ REFERENCES:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book.
4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech. (HVAC)

DISASTER MANAGEMENT (Audit Course - I & II)

Prerequisite: None

Course Objectives: Students will be able to

- learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- critically understand the strengths and weaknesses of disaster management approaches,
- planning and programming in different countries, particularly their home country or the countries they work in

UNIT-I:

Introduction:

Disaster: Definition, Factors and Significance; Difference Between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

Disaster Prone Areas in India:

Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics

UNIT-II:

Repercussions of Disasters and Hazards:

Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

UNIT-III:

Disaster Preparedness and Management:

Preparedness: Monitoring of Phenomena Triggering A Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT-IV:

Risk Assessment Disaster Risk:

Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.

UNIT-V:

Disaster Mitigation:

Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India.

TEXT BOOKS/ REFERENCES:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "New Royal book Company.
2. Sahni, Pardeep Et. Al. (Eds.), " Disaster Mitigation Experiences and Reflections", Prentice Hall of India, New Delhi.
3. Goel S. L., Disaster Administration and Management Text and Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi.

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech. (HVAC)

SANSKRIT FOR TECHNICAL KNOWLEDGE (Audit Course - I & II)

Prerequisite: None

Course Objectives:

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world
- Learning of Sanskrit to improve brain functioning
- Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power
- The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature

Course Outcomes: Students will be able to

- Understanding basic Sanskrit language
- Ancient Sanskrit literature about science & technology can be understood
- Being a logical language will help to develop logic in students

UNIT-I:

Alphabets in Sanskrit,

UNIT-II:

Past/Present/Future Tense, Simple Sentences

UNIT-III:

Order, Introduction of roots,

UNIT-IV:

Technical information about Sanskrit Literature

UNIT-V:

Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

TEXT BOOKS/ REFERENCES:

1. "Abhyaspustakam" – Dr. Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech. (HVAC)

VALUE EDUCATION (Audit Course - I & II)

Prerequisite: None

Course Objectives: Students will be able to

- Understand value of education and self- development
- Imbibe good values in students
- Let the should know about the importance of character

Course outcomes: Students will be able to

- Knowledge of self-development
- Learn the importance of Human values
- Developing the overall personality

UNIT-I:

Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Value judgements

UNIT-II:

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline

UNIT-III:

Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline, Punctuality, Love and Kindness.

UNIT-IV:

Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature

UNIT-V:

Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation, Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively

TEXT BOOKS/ REFERENCES:

1. Chakroborty, S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech. (HVAC)

CONSTITUTION OF INDIA (Audit Course - I & II)

Prerequisite: None

Course Objectives: Students will be able to:

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

Course Outcomes: Students will be able to:

- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.

UNIT-I:

History of Making of the Indian Constitution: History Drafting Committee, (Composition & Working),
Philosophy of the Indian Constitution: Preamble, Salient Features.

UNIT-II:

Contours of Constitutional Rights & Duties: Fundamental Rights Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT-III:

Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualification, Powers and Functions.

UNIT-IV:

Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.

UNIT-V:

Election Commission: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

TEXT BOOKS/ REFERENCES:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

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M. Tech. (HVAC)

PEDAGOGY STUDIES (Audit Course - I & II)

Prerequisite: None

Course Objectives: Students will be able to:

- Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

Course Outcomes: Students will be able to understand:

- What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

UNIT-I:

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions. Overview of methodology and Searching.

UNIT-II:

Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.

UNIT-III:

Evidence on the effectiveness of pedagogical practices, Methodology for the indepth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT-IV:

Professional development: alignment with classroom practices and follow-up support, Peer support, Support from the head teacher and the community. Curriculum and assessment, Barriers to learning: limited resources and large class sizes

UNIT-V:

Research gaps and future directions: Research design, Contexts, Pedagogy, Teacher education, Curriculum and assessment, Dissemination and research impact.

TEXT BOOKS/ REFERENCES:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.

4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech. (HVAC)

STRESS MANAGEMENT BY YOGA (Audit Course - I & II)

Prerequisite: None

Course Objectives:

- To achieve overall health of body and mind
- To overcome stress

Course Outcomes: Students will be able to:

- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

UNIT-I:

Definitions of Eight parts of yog. (Ashtanga)

UNIT-II:

Yam and Niyam.

UNIT-III:

Do's and Don't's in life.

- i) Ahinsa, satya, astheya, bramhacharya and aparigraha
- ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

UNIT-IV:

Asan and Pranayam

UNIT-V:

- i) Various yog poses and their benefits for mind & body
- ii) Regularization of breathing techniques and its effects-Types of pranayam

TEXT BOOKS/ REFERENCES:

1. 'Yogic Asanas for Group Training-Part-I': Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech. (HVAC)

PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS
(Audit Course - I & II)

Prerequisite: None

Course Objectives:

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

Course Outcomes: Students will be able to

- Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
- The person who has studied Geeta will lead the nation and mankind to peace and prosperity
- Study of Neetishatakam will help in developing versatile personality of students

UNIT-I:

Neetisatakam-Holistic development of personality

- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)

UNIT-II:

Neetisatakam-Holistic development of personality

- Verses- 52,53,59 (don't's)
- Verses- 71,73,75,78 (do's)

UNIT-III:

Approach to day to day work and duties.

- Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48,
- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,
- Chapter 18-Verses 45, 46, 48.

UNIT-IV:

Statements of basic knowledge.

- Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68
- Chapter 12 -Verses 13, 14, 15, 16,17, 18
- Personality of Role model. Shrimad Bhagwad Geeta:

UNIT-V:

- Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
- Chapter 4-Verses 18, 38,39
- Chapter18 – Verses 37,38,63

TEXT BOOKS/ REFERENCES:

1. "Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata.
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.