MALLA REDDY COLLEGE OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF MECHANICAL ENGINEERING
COURSE STRUCTURE
M.TECH (THERMAL ENGINEERING)

I Year I Semester

S.NO.	SUBJECT CODE	SUBJECT	L	T/P/D	C
1	R22D2101	Advanced Thermodynamics	3	-	3
2	R22D2102	Advanced Fluid Mechanics	3	-	3
3	R22D2103 R22D2104 R22D2105	1. Cryogenic Engineering 2. Solar Energy Technology 3. Refrigeration and Air Conditioning	3	-	3
4	R22D2106 R22D2107 R22D2108	1. Advanced I.C. Engines 2. Design of Heat Exchangers 3. Energy and Environmental Engineering	3	-	3
5	R22D2181	Energy Engineering Lab	-	4	2
6	R22D2182	Advanced Fluid Mechanics Lab		4	2
7	R22DHS53	Research Methodology & IPR	2		2
8	R22DHS54*	Value Education	2	-	0
Total			16	8	18

***Audit course: Non-credit course, 50% of scoring is required for the award of the degree**

I Year II Semester

S.NO.	SUBJECT CODE	SUBJECT	L	T/P/D	C
1	R22D2109	Advanced Heat and Mass Transfer	3	-	3
2	R22D2110	Thermal and Nuclear Power Plants	3	-	3
3	R22D2111 R22D2112 R22D2113	1. Energy Management 2. Computational Fluid Dynamics 3. Gas Dynamics and Turbo Machinery	3	-	3
4	R22D1503 R22D2114 R22D2115	1. Advanced Finite Element Analysis 2. Industrial Refrigeration Systems 3. Nanofluids	3	-	3
5	R22D2183	Advanced Heat Transfer Lab	-	4	2
6	R22D2184	Computational Fluid Dynamics Lab		4	2
7	R22D2191	Mini Project	2		2
8	R22DHS55*	English for Research Paper Writing	2	-	0
Total			16	8	18

***Audit course: Non-credit course, 50% of the scoring is required for the award of the degree**

II Year I Semester

S.NO.	SUBJECT CODE	SUBJECT	L	T/P/D	C
1	R22D2116 R22D2117 R22D2118	1. Fuels & Combustion 2. Convective Heat Transfer 3. Advanced Materials for Thermal Systems	3	-	3
2		OPEN ELECTIVE	3	-	3
3	R22D2185	Dissertation Phase-I	-	12	6
Total			6	12	12

OPEN ELECTIVE	
Subject Code	Subject Name
R22DME51	Non-Conventional Energy Sources
R22DME52	Industrial Safety
R22DME53	Operations Research
R22DHS51	Business Analytics
R22DCS51	Scripting Languages
R22DAE51	Mathematical Modeling Techniques
R22DEC51	Embedded Systems Programming

II Year II Semester

S.NO.	SUBJECT CODE	SUBJECT	L	T/P/D	C
1	R22D2186	Dissertation Phase-II	-	12	6
2	R22D2187	Dissertation Project Viva Voce	-	28	14
Total			-	40	20

I YEAR
I SEMESTER

MALLA REDDY COLLEGE OF ENGINEERING AND TECHNOLOGY

M.Tech TE I Year I Sem **L/P/C**
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(R22D2101) ADVANCED THERMODYNAMICS

Course Objectives:

- This course aims to provide a good platform to mechanical engineering students to understand, model and appreciate concept of dynamics involved in thermal energy transformation.
- To understand the nature and operating principles of systems involving energy flows.
- To describe and apply basic thermodynamic principles to analyze and predict performance of idealized forms of thermodynamic systems.
- To describe and assess benefits of improvements to thermodynamic systems.
- To relate idealized thermodynamic system models to corresponding real systems.

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 Vent 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's 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.

Course Outcomes:

- Provide in-depth knowledge on fundamental and applied thermodynamics and clear understanding of basic principles of work and energy conversion.
- To appreciate concepts learnt in fundamentals laws of thermodynamics from which learning ideas how to sustain in energy crisis.
- Understand the combustion phenomenon and its reaction using mathematical models.
- To identify and formulate power production based on the fundamentals laws of thermal engineering
- To apply the knowledge of mathematics, science and engineering fundamentals to model the energy conversion phenomenon.

TEXT BOOKS:

1. P.K. Nag, “Engineering Thermodynamics”, 4 th Edition, Tata McGraw-Hill Education Private Limited, 2010.
2. S.S. Thipse, “Advanced Thermodynamics”, Narosa Publishing House, New Delhi, 2013
3. Thermal Engineering by R.K.Rajput, Lakshmi Publications.

REFERENCE BOOKS:

1. Y.A. Cengel and M.A. Boles, “Thermodynamics – An Engineering Approach”, 5 th Edition in SI Units, Tata McGraw Hill Publishing Company Limited, New Delhi, 2006.
2. C. Borganakke and R.E. Sonntag, “Fundamentals of Thermodynamics”, 7 th Edition, Wiley India, Delhi, 2012.
3. Van P. Carey, “Statistical thermodynamics and micro scale thermo physics”, Cambridge University Press, 1999

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M.Tech TE I Year I Sem **L/T/P/C**
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(R22D2102) ADVANCED FLUID MECHANICS

Course Objectives:

- To understand the laws of fluid flow for ideal and viscous fluids.
- To represent the real solid shapes by suitable flow patterns and to analyze the same for aerodynamic performances.
- To understand the changes in properties of incompressible flow and shock expansion.
- To make the student understand the concepts of boundaries.
- To make the student capable to establish a relation between fluid flow and concepts of thermodynamics.

UNIT-I

In Viscid Flow of Incompressible Fluids: Lagrangian and Eulerian Descriptions of fluid motion- Path lines, Streamlines, Streak lines, stream tubes velocity of a fluid particle, types of flows, Equations of tthree-dimensional continuity equation- Stream and Velocity potential functions.

Basic Laws of Fluid Flow: Condition for irrotationality, circulation & vorticity Accelerations in Cartesian systems normal and tangential accelerations, Euler's, Bernoulli equations in 3D– Continuity and Momentum Equations.

UNIT-II

Viscous Flow: Derivation of Navier-Stokes Equations for viscous compressible flow – Exact solutions to certain simple cases: Plain Poisoulle flow - Coutte flow with and without pressure gradient - Hagen Poisoulle flow - Blasius solution.

UNIT-III

Boundary Layer Concepts: Prandtl's contribution to real fluid flows – Prandtl's boundary layer theory - Boundary layer thickness for flow over a flat plate – Approximate solutions – Creeping motion (Stokes) – Oseen's approximation - Von-Karman momentum integral equation for laminar boundary layer –– Expressions for local and mean drag coefficients for different velocity profiles.

UNIT-IV

Turbulent Flow: Fundamental concept of turbulence – Time Averaged Equations –Boundary Layer Equations - Prandtl Mixing Length Model - Universal Velocity

Distribution Law: Van Driest Model –Approximate solutions for drag coefficients – More Refined Turbulence Models – k-epsilon model - boundary layer separation and form drag – Karman Vortex Trail, Boundary layer control, lift on circular cylinders

Internal Flow: Smooth and rough boundaries – Equations for Velocity Distribution and frictional Resistance in smooth rough Pipes – Roughness of Commercial Pipes – Moody's diagram.

UNIT –V

Compressible Fluid Flow – I: Thermodynamic basics–Equations of continuity, Momentum, and Energy - Acoustic Velocity Derivation of Equation for Mach Number–Flow Regimes–Mach Angle–Mach Cone–Stagnation State

Compressible Fluid Flow – II: Area Variation, Property Relationships in terms of Mach number, Nozzles, Diffusers – Fanno and Rayleigh Lines, Property Relations – Isothermal Flow in Long Ducts – Normal Compressible Shock, Oblique Shock: Expansion and Compressible Shocks – Supersonic Wave Drag.

Course Outcomes:

- To apply knowledge of mathematics, science, and engineering in compressible and incompressible fluid flows.
- To understand and analyse the concept of viscous fluids
- To derive the governing equations of fluid flow and apply them to simple flow problems.
- To understand the turbulent flow and develop models using Moody's diagram
- Emphasizing the mathematical formulation of various flow problems

TEXT BOOKS

1. Fluid Mechanics and Machines/Modi and Seth/Standard Book House
2. Fluid Mechanics/Cohen and Kundu/Elsevier/5th edition
3. Fluid Mechanics/Potter/Cengage Learning

REFERENCE BOOK:

1. Fluid Mechanics and Machines/CP Kodandaraman/New Age Publications
2. A Text book of Fluid Mechanics/RK Rajput/S. Chand
3. Boundary Layer Theory/ Schlichting H /Springer Publications

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M.Tech TE I Year I Sem **L/P/C**
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(R22D2103) CRYOGENIC ENGINEERING

(PROGRAM ELECTIVE–I)

Course Objectives:

- To provide an introductory knowledge of Cryogenic Engineering.
- To provide the fundamentals of cryogenics
- To understand the behavior of materials at low temperatures.
- To accustom with various methods of production of cryogenic fluids
- To develop skills for designing cryogenic systems including refrigeration, storage & transfer of cryogens, and instrumentation.

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, CryoCoolers

UNIT-V

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

Course Outcomes:

- Understanding the basics of cryogenic engineering
- Knowledge of liquefaction systems of gases
- Attaining the knowledge of gas mixtures and its separation processes
- Gaining cryogenic refrigeration systems working medium such as solids, gases and liquids
- Apply cryogenic systems to various industries

TEXTBOOKS:

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

REFERENCE BOOKS:

1. Experimental Techniques in Low Temperature Physics- O.K. White, Oxford Press, 1968
2. Cryogenic Process Engineering/ K.D. Timmerhaus & TM Flynn/ Plenum Press, 1998
3. Hand Book of Cryogenic Engineering – J.G.Weisend –II, Taylor and Francis.

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I Year M.Tech TE I Sem **L/P/C**
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(R22D2104) SOLAR ENERGY TECHNOLOGY
(PROGRAM ELECTIVE-I)

Course Objectives:

- To introduce the basic concepts and novel technologies in solar thermal systems
- Understanding basic characteristics of renewable sources of energy and technologies for their utilization
- To give review on thermal storage of energy
- To provide a balance between both frontier technology updates and existing solar thermal energy strategies, in both quantitative and qualitative way.
- To give review on cost and economics and regulatory rules related to utilization of renewable sources of energy

UNIT-I

Introduction – Solar energy option, specialty and potential – Sun – Earth – Solar radiation, beam and diffuse – measurement – estimation of average solar radiation on horizontal and tilted surfaces – problems – applications.

Capturing solar radiation – physical principles of collection – types – liquid flat plate collectors – construction details – performance analysis – concentrating collection – flat plate collectors with plane reflectors – cylindrical parabolic collectors – Orientation and tracking – Performance Analysis.

UNIT-II

Design of Solar Water Heating System and Layout: Power generation – solar central receiver system – Heliostats and Receiver – Heat transport system – solar distributed receiver system – Power cycles, working fluids and prime movers, concentration ratio.

UNIT-III

Thermal Energy Storage: Introduction – Methods of sensible heat storage using solids and liquids – Packed bed storage – Latent heat storage – working principle – construction – application and limitations. Other solar devices – stills, air heaters, dryers, Solar Ponds & Solar Refrigeration, active and passive heating systems

UNIT-IV

Direct Energy Conversion: solid-state principles – semiconductors – solar cells –performance – modular construction – applications - conversion efficiencies calculations.

UNIT-V

Economics: Principles of Economic Analysis – Discounted cash flow – Solar system – life cycle costs – cost benefit analysis and optimization – cost-based analysis of water heating and photo voltaic applications.

TEXTBOOKS:

1. Principles of solar engineering/ Kreith and Kerider/Taylor and Franscis/2nd edition.
2. Solar energy thermal processes/ Duffie and Beckman/John Wiley & Sons.
3. Solar energy: Principles of Thermal Collection and Storage/ Sukhatme/TMH/2nd Edition.

REFERENCE BOOKS:

1. Solar energy/ Garg/TMH.
2. Solar energy/ Magal/Mc Graw Hill.
3. Solar Thermal Engineering Systems / Tiwari and Suneja/Narosa.

Course Outcomes:

1. Define basic properties of solar energy renewable source of energy and technologies for their Utilization.
2. Describe main elements of solar water heating systems designed for utilization of renewable sources of energy.
3. Discuss the aspects of thermal energy storage in relation to natural and human aspects of the environment.
4. Undertake simple analysis of DEC principles and performance calculations.
5. To understand and analyze the principle of economic analysis in solar photo voltaic application systems.

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M.Tech TE I Year I Sem **L/P/C**
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(R22D2105) REFRIGERATION AND AIR CONDITIONING
(PROGRAM ELECTIVE–I)

Course Objectives:

- Learning the fundamental principles and different methods of refrigeration and air conditioning.
- Study of various refrigeration cycles and evaluate performance using Mollier charts and/ or refrigerant property tables.
- Comparative study of different refrigerants with respect to properties, applications and environmental issues.
- Understand the basic air conditioning processes on psychometric charts, calculate cooling load for its applications in comfort and industrial air conditioning.
- Study of the various air conditioning operating principles, and cooling load estimation

UNIT–I

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–II

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–III

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–IV

Air Conditioning: Psychometric properties and processes – Construction of Psychometric 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–V

Air Conditioning Systems: All Fresh air, Re-circulated air with and 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 and diffusers – Fans and blowers – Measurement and control of Temperature and Humidity.

Course Outcomes:

- Illustrate the fundamental principles and applications of refrigeration and air conditioning system
- Obtain cooling capacity and coefficient of performance by conducting test on vapor compression refrigeration systems
- Use of P-h, T-S and Psychrometric charts to solve refrigeration and Air conditioning design
- Calculate cooling load for air conditioning systems used for various applications
- Operate and analyze the refrigeration and air conditioning systems.

TEXTBOOKS:

1. Refrigeration & Air Conditioning /C.P. Arora/TMH.
2. Refrigeration & Air Conditioning /Arora & Domkundwar/ Dhanpat Rai.
3. Refrigeration and Air Conditioning /Manohar Prasad.

REFERENCE BOOKS:

1. Principles of Refrigeration/ Dossat /Pearson.
2. Refrigeration and Air Conditioning /Ananthanarayana /TMH.
3. Refrigeration and Air Conditioning /Jordan& Preister /Prentice Hall.

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M.Tech TE I Year I Sem **L/P/C**
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(R22D2106) ADVANCED I.C. ENGINES
(PROGRAM ELECTIVE–II)

Course Objectives:

- Analyze engine cycles and the factors responsible for making the cycle different from the ideal cycle.
- To familiarize with volumetric efficiency, turbulent motion, flow characteristics,
- Understand combustion phenomenon in SI engine and CI engines.
- Outline emission formation mechanism of IC engines, its effects and the legislation standards.
- Understand the latest developments in IC Engines and alternate fuels

UNIT-I

Introduction – Historical Review – Engine Types – Design and operating Parameters.

Cycle Analysis: Thermo-chemistry of Fuel – Air mixtures, properties – Ideal Models of Engine cycles– Real Engine cycles - differences and Factors responsible for Computer Modeling.

UNIT -II

Gas Exchange Processes: Volumetric Efficiency – Flow through ports – Supercharging and Turbo charging.

Charge Motion: Mean velocity and Turbulent characteristics – Swirl, Squish – Pre-chamber Engine flows.

UNIT -III

Engine Combustion in SI Engines: Combustion and Speed – Cyclic Variations – Ignition – Abnormal combustion - Fuel factors, MPFI, SI engine testing.

Combustion in CI Engines: Essential Features – Types of Cycle. Pr. Data – Fuel Spray Behavior – Ignition Delay – Mixing Formation and control, Common rail fuel injection system.

UNIT -IV

Pollutant Formation and Control: Nature and extent of problems – Nitrogen Oxides, Carbon monoxide, unburnt Hydrocarbon and particulate – Emissions – Measurement – Exhaust Gas Treatment, Catalytic converter, SCR, Particulate Traps, Lean, NO_X, Catalysts.

UNIT -V

Engine Heat Transfer: Importance of heat transfer, heat transfer and engine energy balance, Convective heat transfer, radiation heat transfer, Engine operating characteristics. Fuel supply systems for S.I. and C.I engines to use gaseous fuels like LPG, CNG and Hydrogen.

Modern Trends in IC Engines: Lean Burning and Adiabatic concepts, Rotary Engines, Modification in I.C engines to suit Bio – fuels, HCCI and GDI concepts.

TEXTBOOKS:

1. I.C. Engines / V.Ganesan/TMH
2. I.C. Engines Fundamentals/Heywood/TMH
3. I.C. Engines/G.K. Pathak & DK Chevan/ Standerd Publications

REFERENCE BOOKS:

1. I.C. Engines /RK Rajput/Laxmi Publications
2. Computer Simulation of C.I. Engine Process/ V.Ganesan/University Pre
3. Advanced I.C Engines by Senthil.

Course Outcomes:

- To apply thermodynamics laws in engineering applications.
- To demonstrate thermodynamic analysis to IC engines and describe combustion phenomena in spark ignition and compression ignition engines.
- To apply the knowledge of operating characteristics of common internal combustion engines.
- Evaluate the methods of engine emission control techniques and implement viable alternate fuels.
- Ability and information to follow recent developments about the internal combustion engine technology

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I Year M.Tech TE I Sem **L/P/C**
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(R22D2107) DESIGN OF HEAT EXCHANGERS
(PROGRAM ELECTIVE–II)

Course Objectives:

- To understand the components and importance of heat exchangers used in industry.
- Familiarize with the thermal and stress analysis on various parts of the heat exchangers.
- To understand the heat transfer and design of double pipe heat exchangers.
- Familiarize with the sizing and rating of the heat exchangers for various applications.
- To know the parameters required for the design of condensers and cooling towers.

UNIT-I

Fundamentals of Heat Exchanger: Temperature distribution and its implications types–shell and tube heat exchangers–regenerators and recuperators – analysis of heat exchangers–LMTD and effectiveness method.

UNIT-II

Flow and Stress Analysis: Effect of turbulence – friction factor–pressure loss–stress in tubes–header sheets and pressure vessels– thermal stresses, shear stresses- types of failures.

UNIT-III

Design Aspects: Heat transfer and pressure loss–flow configuration–effect of baffles–effect of deviations from ideality – design of double pipe - finned tube – shell and tube heat exchangers - simulation of heat exchangers.

UNIT–IV

Compact and Plate Heat Exchangers: Types – merits and demerits – design of compact heat exchangers, plate heat exchangers–performance influencing parameters– limitations

UNIT-V

Condensers and Cooling Towers: Design of surface and evaporative condensers–cooling tower–performance characteristics.

TEXT BOOKS:

1. Sadik Kakac and HongtanLiu, Heat Exchangers Selection, Rating and Thermal Design, CRC Press, 2002.
2. Fundamentals of Heat Exchanger Design by Ramesh K. Shah, Dusan P. Sekulic.
3. Plate Heat Exchangers: Design, Applications and Performance by Bengt Sundén, R. M.Manglik.

REFERENCE BOOKS:

1. Arthur. PFrass, Heat Exchanger Design, John Wiley & Sons, 1988
2. Taborek.T, Hewitt.G.F and Afgan.N, Heat Exchangers, Theory and Practice.McGraw-Hill Book. Hewitt.G.F, Shires. G.L and Bott.T.R, Process Heat Transfer, CRC Press, 1994.

Course Outcomes:

- Abilitytodesigntheheatexchangerbasedontheinformationprovidedforaparticularappli cation.
- To analyze the parameters which influence the flow, stress on heat exchangers.
- Ability to design different types of heat exchangers based on flow configuration and heat transfer.
- Analyze problems involved in heat transfer and simulation of heat exchangers.
- Able to design surface and evaporative condensers based on performance characteristics.

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M.Tech TE I Year I Sem **L/P/C**
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(R22D2108) ENERGY AND ENVIRONMENTAL ENGINEERING
(PROGRAM ELECTIVE–II)

Course Objectives:

- To understand and learn the principles of air and water pollution, the effect of these pollutants on the environment.
- To know the methods available to control air pollution and water pollution.
- Familiarize with the sources of waste and energy generation from waste.
- Thorough knowledge of the energy conservation act and its features.
- Familiarize with waste heat recovery systems and their applications.

UNIT-I

Introduction to Pollution: Pollution of air, water, and soil; Effect of pollution on living systems.

Air Pollution: Sources and classification of air pollutants, Effect of air pollution, Pollution from industries, Chemical reactions in a contaminated atmosphere, urban air pollution, Greenhouse effect, Ozone layer depletion, Acid rain, Photochemical smog, Meteorological aspects of air pollution.

Air Pollution Sampling and Measurement: Collection of gaseous and particulate pollutants, Analysis of air pollutants – Sulphur dioxide, Nitrogen oxides, Carbon monoxide, Oxidants and Ozone, Hydro carbons, and Particulate matter.

UNIT–II

Air Pollution Control Methods and Equipment: Cleaning of gaseous effluents, Particulate emission control, Control of specific gaseous pollutants SO_2, NOx, Hydrocarbons, CO.

Water Pollution and Control: Types of water pollutants and their effects - Thermal pollution and effects - Water pollution laws and standards - Wastewater sampling and analysis - Treatment of wastewater (primary, secondary, and tertiary treatment processes).

UNIT–III

Waste to Energy Conversion: Sources and classification of wastes - Energy generation from wastes - Biochemical Vs Thermo-Chemical Conversion and their environment benefits - Introduction to Biochemical conversion (anaerobic digestion) - Thermo-chemical conversion processes direct combustion, incineration, pyrolysis, gasification and liquefaction. Economics of thermo-chemical conversion - Industrial applications of incinerators and gasifiers - Briquetting; Utilization and advantages of briquetting.

UNIT–IV

Energy Conservation in Industry: Energy Conservation and its Importance - Energy Strategy for the Future - The Energy Conservation Act, 2001 and its Features - Energy conservation in Boilers, Steam Turbines and Cooling Towers.

UNIT–V

Waste Heat Recovery: Introduction - Classification and Application - Benefits of Waste Heat Recovery - Development of a Waste Heat Recovery System.

TEXT BOOKS:

1. "Environmental pollution control engineering" C. S. Rao/New age International Pvt.Ltd
2. "Air pollution" M.N.Rao and M.V.N.Rao /Tata Mc Graw Hill
3. G.Masters: Introduction to Environmental Engineering and Science Prentice Hall of India Pvt Ltd, NewDelhi -2003.

REFERENCE BOOKS:

1. "Pollution control in process industries" S.P. Mahajan/ Tata Mc Graw Hill
2. "Energy Technology" S.Rao and B.B.Parulekar /Khanna publishers
3. H.S.Peavy, D.R..Rowe, G.Tchobanoglous (1985): Environmental Engineering McGraw- Hill BookCompany, NewYork.

Course Outcomes:

- To analyze the gaseous pollutants such as nitrogen oxides, sulfur dioxide, carbon monoxide, etc.
- Ability to justify the use of pollution control equipment and its design.
- Apply the knowledge about the operations of Waste to Energy Plants.
- Carry out Techno-economic feasibility for Waste to Energy Plants.
- To develop and implement waste heat recovery systems.

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M.Tech TE I Year I Sem **L/P/C**
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(R22DHS53) RESEARCH METHODOLOGY & IPR

Course Objectives

- Demonstrate the ability to choose methods appropriate to research aims and objectives
- Identify appropriate research topics
- Prepare a project proposal (to undertake a project) • organize and conduct research (advanced project) in a more appropriate manner
- Write a research report and thesis
- Write a research proposal (grants)

UNIT - I

Introduction: Research objective and motivation, Types of research, Research approaches, Significance, Research method vs. methodology, Research process.

UNIT - II

Formulating a research problem: Literature review, Formulation of objectives, Establishing Operational definitions, identifying variables, constructing hypotheses.

UNIT - III

Research design and Data Collection: Need and Characteristics, Types of research design, Principles of Experimental research design, Method of data collection, Ethical issues in collecting data.

UNIT - IV

Sampling and Analysis of data: Need of Sampling, Sampling distributions, Central limit theorem, Estimation: mean and variance, Selection of sample size Statistics in research, Measures of Central tendency, Dispersion, asymmetry and relationships, Correlation and Regression analysis, Displaying data

UNIT - V

Hypothesis Testing: Procedure, Hypothesis testing for difference in mean, variance limitations, Chi-square test, Analysis of variance (ANOVA), Basic principles and techniques of writing a Research Proposal

Text Books:

1. R. C. Kothari, Research Methodology: Methods and Techniques, 2nd edition, New Age International Publisher, 2009

2. Ranjit Kumar, Research Methodology: A Step-by-Step Guide for Beginners, 2nd Edition, SAGE, 2005

References:

1. Trochim, William M. The Research Methods Knowledge Base, 2nd Edition. Internet WWW page, at URL: <http://www.socialresearchmethods.net/kb/>
2. (Electronic Version): StatSoft, Inc. (2012). Electronic Statistics Textbook. Tulsa, OK: StatSoft. WEB: http://www.statsoft.com/textbook/.(Printed Version): Hill, T. & Lewicki, P. (2007). STATISTICS: Methods and Applications. StatSoft, Tulsa, OK.

Course Outcomes:

- Develop understanding on various kinds of research, objectives of doing research, research process, research designs and sampling.
- Construct a coherent research proposal that includes an abstract, introduction, literature review, research questions, ethical considerations, and methodology
- Have basic knowledge on qualitative research techniques
- Have adequate knowledge on measurement & scaling techniques as well as the quantitative data analysis
- Have basic awareness of data analysis-and hypothesis testing procedures.

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M.Tech TE I Year I Sem **L/P/C**

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(R22D2181) ENERGY ENGINEERING LABORATORY

Course Objectives:

- To understand the working principles of I.C. engines.
- To learn the testing methods used to measure the performance parameters of an engine.
- To demonstrate and conduct experiments.
- Familiarize with solar panel power systems.
- To understand the working principles of refrigeration systems.

LIST OF EXPERIMENTS:

1. Load test on four stroke single cylinder diesel engine using biodiesels.
2. Measurement of Burning Velocity of premixed flame.
3. To study V-I characteristics of solar panels.
4. Performance test and analysis of exhaust gases of an I.C engine.
5. Heat balance sheet, volumetric efficiency, and air-fuel ratio estimation of an I.C. Engine.
6. COP estimation of vapor compression refrigeration system.
7. To estimate power generation from the solar photovoltaic systems.
8. Performance analysis of heat pipe.
9. To study the performance of solar flat plate collectors.
10. A study on Evacuative tube concentrators.

Any 8 experiments may be conducted

Course Outcomes:

- Analyze the performance and exhaust emissions of an IC engine.
- Evaluate the performance of the Vapor compression and Air conditioning units.
- Analyze the flame propagation velocity of the gaseous fuels.
- Evaluate the performance of the solar flat plate collector and evacuated tube concentrator.
- To carry out the test on power generation and V-I characteristics of solar power systems.

MALLA REDDY COLLEGE OF ENGINEERING AND TECHNOLOGY

M.Tech TE I Year I Sem **L/P/C**

-/3/2

(R22D2182) ADVANCED FLUID MECHANICS LAB

Objectives:

- To gain knowledge in performance testing of Hydraulic Turbines and Hydraulic Pumps at a constant speed and head.
- To provide practical knowledge in the verification of principles of fluid flow.
- To calculate C_d, C_c, C_v, and Coefficient of the impact of various hydraulic systems
- To understand Major and minor losses.
- Student able to learn about measuring pressure, discharge, and velocity of fluid flow.

List of Experiments

1. Determination of co-efficient of discharge of venturimeter.
2. Determination of co-efficient of discharge of Orifice meter.
3. Determination of friction loss in a piping system.
4. Determination of major and minor losses in a piping system.
5. Jet Impact on flat and curved Vanes.
6. Performance Test on Pelton Wheel and plot characteristic curves & determination of efficiency.
7. Performance Test on Francis Turbine and plot characteristic curves & determination of efficiency.
8. Performance Test on Kaplan Turbine and plot characteristic curves & determination of efficiency.
9. Performance Test on Single Stage Centrifugal Pump and plot characteristic curves.
10. Performance Test on Positive displacement pump and plot characteristic curves.

Note: Total 8 experiments are to be conducted.

Outcomes:

1. To provide the students' knowledge in calculating performance analysis in turbines.
2. Students' exposure to study various operating characteristics of Centrifugal pump and positive displacement pump.
3. Analyze a variety of fluid flow devices and utilize fluid mechanics principles in design.
4. Get Exposure to various losses in a piping system.
5. To provide the students with a solid foundation in fluid flow principles.

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M.Tech TE I Year I Sem **L/P/C**
2/-/-

(R22DHS54) VALUE EDUCATION
(AUDIT COURSE –I)

Course Objectives:

- To expose the student to the need for values, ethics, self-develop,ment and standards
- To make the student understand the meaning of different values including duty, devotion, self-reliance, etc.
- To inculcate personality and behaviour development among professionals.
- To imbibe the different behavioural competencies in students for leading an ethical and happy life
- To expose the student to different characteristic attributes and competencies for leading a successful, ethical and happy professional life

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 judgments

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 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 IV:

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:

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

Course Outcomes:

- Appreciate the need for human values and methods for self-development
- Elaborate the different traits and benefits of a self-developed individual
- List the different attributes of self-developed individual
- Understand personality development and professional behavior.
- Elaborate the role and scope of books/faith/health/religions in character building and competence development

I YEAR
II SEMESTER

MALLA REDDY COLLEGE OF ENGINEERING AND TECHNOLOGY

M.Tech TE I Year II Sem **L/P/C**
3/-/3

(R22D2109) ADVANCED HEAT AND MASS TRANSFER

Course Objectives:

- To develop the ability to use the heat transfer modes.
- To analyze the thermal analysis and sizing of heat exchangers and to learn the heat transfer coefficient for compact heat exchanges.
- To understand the various types of flows and applying in empirical equations
- To understand and analyze boiling and condensation through geometrics
- Toachieveanunderstandingofthebasicconceptsofphasechangeprocesses

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-bousisinesq approximation-different geometries-combined free and forced convection.

Boiling and condensation: Boiling curve-correlations-Nusselt's 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, spherical surfaces, and gas radiation-radiation from flames. Mass Transfer: Concepts of mass transfer-diffusion & convective mass transfer analogies-significance of non-dimensional numbers.

TEXTBOOKS:

Principles of Heat Transfer/Frank Kreith/Cengage Learning Elements of Heat Transfer/E. Radha Krishna/CRC Press/2012 Heat Transfer/RK Rajput/S.Chand

REFERENCE BOOKS:

1. Introduction to Heat Transfer/SK Som/PHI
2. Engineering Heat & Mass Transfer/Mahesh Rathore/Lakshmi Publications
3. Heat Transfer / Necati Ozisik / TMH

Course Outcomes:

- On successful completion of this course the student will be able to apply various correlations for heat transfer calculations.
- To present fundamentals of momentum, heat and mass transfer and to introduce general conservation equation for transport phenomena.
- To analyze empirical relations to variation geometries for laminar and turbulent flows.
- To understand radiation heat transfer in grey body and non-grey bodies.
- To understand analogy between momentum, heat and mass transfer.

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M.Tech TE I Year II Sem **L/P/C**
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(R22D2110) THERMAL AND NUCLEAR POWER PLANTS

Course Objectives:

- Provide awareness about resources of energies available in India for Power Production by Thermal and Nuclear Processes.
- Understand and know the requirements for a Thermal Power Plant and Nuclear Power Plant, from sources to consumption and economics of power plants.
- Study and learn the processes and cycles followed in Thermal Power Plants and nuclear power plants and components used in the power plants.
- Gain the knowledge on steam power plants, steam generators and gas turbine power plants, their analyses on fuel and fluidized bed combustion, ash handling systems.
- Understanding the power plant instrumentation

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. Flue gas analysis.

Steam Power Plant: Introduction. General layout of steam power plant - Modern coal fired 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, and 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, and disadvantages.

UNIT-III

Nuclear Power Plant: Nuclear physics - Nuclear Reactor - Types of reactors - Site selection. Method of enriching uranium. Applications 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.

TEXTBOOKS:

1. Power Plant Engineering / P.K.Nag/ TMH.
2. Power Plant Engineering / R.K.Rajput / Lakshmi Publications.
3. Power Plant Engineering, by Samsher Gautam, First Edition.

REFERENCE BOOKS:

1. Power Plant Engineering / P.C.Sharma / Kotearia Publications.
2. Power Plant Technology / Wakil.
3. Power Plant Engineering by A.K. Raja, Amit Prakash Srivastava,Manish Dwivedi.

Course Outcomes:

- Describe and analyze different types of sources and mathematical expressions related to thermodynamics and various terms and factors involved with power plant operation.
- Gain the knowledge about resources of energies available in India for Power Production by Thermal and Nuclear Processes.
- Analyze the working and layout of steam power plants and the different systems comprising the plant and discuss about its economic and safety impacts
- Analyze the processes and cycles followed in Thermal Power Plants and nuclear power plants and components used in the power plants and identify the losses to get better efficiency.
- Describe the working principle and basic components of measuring instruments of power plant and pollution control methods involved with it.

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M.Tech TE I Year II Sem **L/P/C**
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(R22D2111) ENERGY MANAGEMENT
(PROGRAM ELECTIVE–III)

Course Objectives:

- To understand the principles associated with effective energy management and to apply these principles in the day-to-day life.
- To minimise energy costs / waste without affecting production & quality.
- To minimize environmental effects.
- To gain exposure to energy auditing.
- To understand the principles associated with effective energy management and to apply these principles in the day-to-day life.

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.

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.

TEXTBOOKS:

1. Energy Management Hand Book / W.C. Turner (Ed)
2. Energy Management Principles / CB Smith/ Pergamum Press
3. Energy Audits: A Workbook for Energy Management in Buildings by E-book by Tarik Al-Shemmeri

REFERENCE BOOKS:

1. Energy Management / W.R.Murthy and G.Mc.Kay / BS Publication
2. Management / H.Koontz and Cyrill Donnel / McGraw Hill Energy Management Hand Book, BSR Publication

Course Outcomes:

- Understanding of energy conservation and identification of energy conservation opportunities in various industrial processes
- Knowledge of various tools and components of energy auditing
- Understanding of energy conservation and identification of energy conservation opportunities in various industrial processes
- Will be able to analyse and estimate the costs involved in completion of a project.
- Gains knowledge about the importance of alternative energy sources in the present scenario.

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M.Tech TE I Year II Sem **L/P/C**
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(R22D2112) COMPUTATIONAL FLUID DYNAMICS
(PROGRAM ELECTIVE–III)

Course Objectives:

- To develop finite difference and finite volume discredited forms of the CFD equations.
- To formulate explicit & implicit algorithms for solving the Euler Equations & Navier Stokes Equations.
- Equip students with the knowledge base essential for the application of computati fluid dynamics to engineering flow problems.
- Provide the essential numerical background for solving the partial differential equations governing the fluid flow
- Develop students' skills in using a commercial software package

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.

Burger's 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, and 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.

TEXTBOOKS:

1. Text book of fluid dynamics/ Frank Choriton/ CBS Publishers & distributors, 1985
2. Numerical heat transfer and fluid flow / Suhas V. Patankar / Hema shava Publishers Corporation & Mc Graw Hill.
3. Computational Fluid Flow and Heat Transfer/ Muralidaran/ Narosa Publications

REFERENCE BOOKS:

1. Computational Fluid Dynamics: Basics with applications/John D. Anderson/ Mc Graw Hill.
2. Fundamentals of Computational Fluid Dynamics/Tapan K. Sengupta / Universities Press.
3. Introduction to Theoretical and Computational Fluid Dynamics/C. Pozrikidis /Oxford. University Press/2nd Edition

Course Outcomes:

- Derive the basic governing equations applied for fluid flow problems & the concept of discretization.
- Apply the differential equations to fluid flow problems.
- Solve simple algorithms for incompressible fluid flow.
- Understand solution using finite volume method.
- Simplify flow problems and solve those exactly using standard variation methods.

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M.Tech TE I Year II Sem **L/P/C**
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(R22D2113) GAS DYNAMICS AND TURBO MACHINERY
(PROGRAM ELECTIVE–III)

Course Objectives:

- To study the significance of Mach number and Mach waves.
- To understand the principles involved in normal shock waves.
- To understand the operation of turbomachinery.
- To understand the different types of compressors such as centrifugal, axial flow compressors, etc.
- To study the performance characteristics and selection of turbomachinery

UNIT-I

Fundamentals of compressible flow: Ideal gas relationship, The adiabatic energy equation, Mach number, and its significance, Mach waves, Mach cone, and Mach angle, static and stagnation states, the relationship between stagnation temperature, pressure, density, and enthalpy in terms of Mach number, stagnation velocity of sound, reference speeds, various regions of flow, Effect of Mach number on compressibility, Area velocity relationship.

UNIT-II

Normal shock Waves: Development of shock wave, Thickness of shock wave, governing equations, Strength of shock waves, Prandtl-Mayer relation, Mach number in the downstream of normal shock, variation of flow parameters across the normal shock, normal shock in Fanno and Rayleigh flows, the impossibility of a rarefaction shock, supersonic diffusers, supersonic pitot tube.

UNIT-III

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 turbomachines Gas Dynamics: Fundamental thermodynamic concepts, isentropic conditions, Mach numbers and area, Velocity relations, Dynamic Pressure, Normal shock relation for a perfect gas. Supersonic flow, oblique shock waves

UNIT-IV

Convergent and Convergent-Divergent nozzles, Energy Balance, Effect of back pressure of analysis. Steam Turbines: Impulse turbines, Compounding, Work done and Velocity triangle, Efficiencies. Centrifugal compressor: Types, Velocity triangles and efficiencies, Blade passage design, Diffuser, and pressure recovery.

UNIT-V

Axial Flow Compressors: Flow Analysis, Work and velocity triangles, Efficiencies, Thermodynamic analysis. Stage pressure rise, Degree of reaction

Axial Flow Gas Turbines: Work done. Velocity triangle and efficiencies, Thermodynamic flow analysis, Degree of reaction. Jet Propulsion-Classification-Thermodynamic analysis-Performance parameters-Rocket Propulsion-Classification-Propulsion systems

Text books/ Reference Books:

1. Gas dynamics by James E A John United States Edition
2. Yahya, S.H, Turbines, Compressor and Fans , Tata Mc Graw Hill
3. Gas Dynamics by Rathakrishnan E, PHI publications.
4. Ganesan .V, Gas Turbines , Tata McGraw Hill Pub. Co., New Delhi.
5. Turbomachinary performance analysis by R I Lewis. Publisher: Butterworth-Heinemann.

Course outcomes:

- To know the effects of shocks and expansions.
- Be able to calculate changes to flows across shocks/expansions.
- Explain the limits of safe operation of compressors
- Use design parameters for characterizing turbo machinery stages
- Recognize and discuss today's and tomorrow's use of turbo machines for enabling a sustainable society.

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M.Tech TE I Year II Sem **L/P/C**
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(R22D1503) ADVANCED FINITE ELEMENT ANALYSIS
(PROGRAM ELECTIVE–IV)

Course Objectives:

- Gain a fundamental understanding of the finite element method for solving boundary value problems.
- Learn important concepts of variation form, minimum potential energy principles, and method of weighted residuals.
- Study one dimensional problems such as truss, beam, and frame members, two-dimensional problems such as plain stress and plain strain elasticity problems, torsion problem.
- Provide complements of Solid and Structural mechanics required for the FEA contents.
- Provide detailed understanding of using FEA to solve advanced structural and solid mechanics problems involving material nonlinearity.

UNIT-I

Introduction to FEM: Basic concepts, historical back ground, applications of FEM, general description, comparison of FEM with other methods, variation approach, Glerkin'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, Iso parametric 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: Tetra hedran element – Jacobian matrix – Stiffness matrix.

UNIT-IV

Scalar Field Problems: 1-D Heat Conduction-Slabs – fins - 2-D heat conduction problems – Introduction to Torsional problems.

UNIT-V

Dynamic Considerations and Dynamic Equations – consistent mass matrix – Eigen Values, Eigen vector, natural frequencies – mode shapes – modal analysis.

TEXTBOOKS:

1. Introduction to Fininte element analysis- S.Md.Jalaludeen, Anuradha Publications, print-2012
2. A First Course in the Finite Element Method/Daryl L Logan/Cengage Learning/5th Edition
3. Finite Element Method – Krishna Murthy / TMH

REFERENCE BOOKS:

1. Introduction to Fininte element analysis- S.Md.Jalaludeen,Anuradha Publications, print-2012
2. A First Course in the Finite Element Method/Daryl L Logan/Cengage Learning/5th Edition
3. Finite Element Method – Krishna Murthy / TMH

Course Outcomes:

- Apply the concepts of minimum potential energy principles to solve structural mechanics problems.
- Compute Eigen values and eigenvectors of simple dynamic systems
- Obtain weak form from strong form and total potential, and recognize similarities between such solutions, and those obtained by variational principles and principal of virtual work.
- Able to demonstrate knowledge of the fundamental concepts of using FEA to model buckling of structures.
- Able to demonstrate knowledge of the fundamental concepts of the theory of plasticity.

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M.Tech TE I Year II Sem **L/P/C**
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(R22D2114) INDUSTRIAL REFRIGERATION SYSTEMS
(PROGRAM ELECTIVE–IV)

Course Objectives:

- To provide concepts of Refrigeration systems in residential, commercial and industrial buildings.
- To impart knowledge of various compressors
- To educate about various system components and accessories of refrigeration systems like evaporators and condensers
- To learn about cycle analysis pertaining to Refrigeration systems.
- To learn about energy conservation and design considerations.

UNIT-I

Introduction: Introduction to industrial refrigeration – difference from conventional system-applications–industrial and comfort air -conditioning-conditions for high COP.

UNIT-II

Compressors: Reciprocating and screw compressor: Multistage industrial applications, cylinder arrangement, cooling methods- oil injection and refrigeration injection, capacity regulations-Economizers.

UNIT-III

Evaporator sand Condensers: Types of Evaporators, Liquid circulation: Mechanical pumping and gas pumping-advantage and disadvantage of liquid re-circulation-circulation ratio-top feed and bottom feed refrigerant-Net Positive Suction Head (NPSH)-two pumping vessel system-suction risers– design –piping loses. Different Industrial Condensers arrangement, Evaporators-Types and arrangement, liquid circulation, type of feed, refrigerant tipping design, functional aspects. Lubricating oil: types-physical properties, types of circulation and oil separator

UNIT-IV

Vessels in Industrial Refrigeration: High pressure receiver, flash tank, liquid and vapour separator, separation enhancers, low pressure receivers, surge drum, surge line accumulator, thermosyphon receiver and oil pots.

UNIT-V

Energy Conservation and Design Considerations- Source of losses, energy efficient components, and heat reclaim thermal storage, ice builder and ice harvester.

Insulation: critical thickness, insulation cost and energy cost, vapour barriers, construction methods of refrigerated spaces.

TEXTBOOKS:

1. WilbertF.Stoecker, Industrial Refrigeration HandBook, McGraw-Hill, 1998.
2. ASHRAEHandBook: Fundamentals, 1997.
3. ASHRAEHandBook: Refrigeration, 1998.

REFERENCE BOOKS:

1. ASHRAE HandBook: HVAC SystemsandEquipment,1996.
2. Transport properties of SUVA Refrigerants, Du-PontChemicals,1993.
3. Refrigeration and Air Conditioning Technology by Bill Whitman, Bill Johnson, John Tomczyk & Eugene Silberstein.

Course Outcome:

- To enable students to demonstrate and apply knowledge of design, select components for, and prepare design documents for industrial Refrigeration systems.
- Analyze performance of compressors in refrigeration system
- Study the working principles of evaporators and condensers of refrigeration system.
- Study the vessels that used in Industrial refrigeration systems
- Evaluate energy conservation and design methods in air conditioning system

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3/-/3

(R22D2115) NANOFLUIDS
(PROGRAM ELECTIVE–IV)

Course Objectives: The course is intended to

- Understanding of superior thermo physical properties of nanofluids
- Understanding of synthesis of nanofluids
- Comparison of heat transfer using nanofluids with conventional fluids
- Understanding of convection and boiling heat transfer
- Research on this new topic to design modern mini and micro channel heat exchangers with nanofluids exhibiting much higher thermal efficiency and saving energy

UNIT-I:

Introduction to nanofluids, nanostructure materials, base fluids, dispersion, sonication and stable suspension. Various types of nanofluids - Volumetric concentration. Thermophysical properties: Density; principles of measurement and apparatus. Theoretical equations and new empirical correlations to determine the density of different nanofluids. Viscosity: principles of measurement and apparatus. Andrade's and other theoretical equations and new empirical correlations to determine the viscosity of different nanofluids. Effect of volumetric concentration and temperature. Effect of subzero temperature on nanofluid viscosity.

UNIT-II:

Thermal conductivity: principles of measurement and apparatus. Hamilton-Crosser and other theoretical equations and new empirical correlations to determine the thermal conductivity of different nanofluids. Effect of volumetric concentration and temperature. Effect of Brownian motion on enhancing the thermal conductivity. Specific heat: principles of measurement and apparatus. Buongeorno's thermal equilibrium equation and other theoretical equations and new empirical correlations to determine the specific heat of different nanofluids. Effect of volumetric concentration and temperature.

UNIT-III:

Combined effects of thermo physical properties of nanofluids on the thermal diffusivity, the Prandtl number, the Reynolds number and the Nusselt number. Basic understanding of their effects on frictional loss and Heat transfer. Convective heat transfer: Single-phase fluid equations, laminar flow, entry length and fully developed friction factor and heat transfer coefficient. Graetz number effect in the entry region. Correlations for friction factor and

Nusselt number for nanofluids. Turbulent flow: Single phase fluid fully developed flow Dittus Boelter and Glienilski equations. Blasius and other turbulent friction factor correlations.Their comparison with nanofluids data. New correlations for turbulent friction factor and Nusselt number for nanofluids.

UNIT-IV:

Principles of measurement and apparatus for the nanofluid convective heat transfer coefficient. Recent empirical relations for convection coefficient of various types of nanofluids. Effect of particle Peclet number. Effect of volumetric concentration. Application of nanofluids to various types of industrial heat exchangers. Heating capacity, mass flow, heat exchanger surface area, LMTD and pumping power for nanofluids versus conventional heat transfer fluids.

UNIT-V:

Application to building heating and cooling Comparison of nanofluids performance with glycol solution in hydronic coils. Application to automobile radiators. Comparison of the performance of nanofluids under arctic and sub-arctic temperatures with glycol solutions. Introduction to electronic cooling in microchannels with nanofluids.

TEXT BOOKS/REFERENCE BOOKS:

1. Microscale and Nanoscale Heat Transfer by C. Sobhan and G. Peterson, First edition, CRC Press.
2. Fluid Mechanics by F. M. White, 5th Edition, McGraw-Hill.
3. Heat Transfer by A. Bejan 2nd Edition, John Wiley.
4. Handbook of Nanostructured Materials and Nanotechnology Vol. I and II - H.S.Nalwa, I edition, American Scientific Publishers.
5. Springer Handbook of Nanotechnology by Bharat Bhushan, 1st edition, Springer-Verlag Publication.

Course Outcomes:

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

- To introduce the application of nanotechnology in the area of fluids and thermal engineering.
- Understand measurement of thermal conductivity and specific heat principles.
- Understand the concept of various dimensionless numbers & it's co-efficient.
- Understand empirical relations of various nanofluids & design the heat exchangers using LMTD.
- Understanding the applications of heating & cooling with alcohol solutions.

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(R22D2191) MINI PROJECT

Course Objectives:

- To be able to apply some of the techniques/principles you have been taught
- To carry out budget and time planning for the project.
- To inculcate implementation skills by basics of design using an appropriate analysis tool.
- To follow correct simulation practices
- To do effective methodology in the mini project

Course Outcomes:

- Demonstrate a through and systematic understanding of project contents.
- Understand methodologies and professional way of documentation and communication.
- Know the key stages in development of the project.
- Extend or use the idea in mini project.
- Create new ideas with the help of fundamentals of Mechanical Engineering

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-/3/2

(R22D2183) ADVANCED HEAT TRANSFER LAB

Course Objectives:

- Student to learn how to find efficiency of the fin experimentally by pin fin apparatus.
- Student can learn how to find overall heat transfer co-efficient experimentally by composite wall apparatus.
- Student to perform how to find heat transfer rate experimentally by logged pipe, concentric sphere, forced, free and condensation apparatus.
- Student to learn how to find effectiveness of heat exchanger experimentally by heat exchanger apparatus.
- Student to understand how to find critical heat flux, emissivity and Stefan Boltzmann constant experimentally by critical heat flux, emissivity and Stefan Boltzmann apparatus

LIST OF EXPERIMENTS:

1. Determination of Forced Convective Heat Transfer Coefficient of air using Forced Convection Apparatus.
2. Determination of Thermal Conductivity of a Metal Rod.
3. Determination of Performance of a Heat Pipe
4. Determination of the effectiveness of Parallel and Counter Flow Heat Exchanger
5. Determination of Condensation Heat Transfer Coefficient under Film and Drop wise condensation conditions.
6. Determination of Stefan Boltzmann Constant.
7. Transient Heat Conduction Experiment.
8. Heat transfer through lagged pipe
9. Determination of Free Convective Heat Transfer Coefficient of air.
10. Emissivity measurement of surfaces.
11. Heat Transfer through a Concentric Sphere
12. Heat transfer enhancement using Nano-fluids.

Note: Any 8 experiments can be conducted.

OUTCOMES:

- Perform steady state conduction experiments to estimate thermal conductivity of different materials for plane, cylindrical and spherical geometries.

- Perform the transient heat conduction experiment and obtain variation of temperature along the length of the pin fin.
- Estimate heat transfer coefficients in forced convection, free convection and determine effectiveness of heat exchangers.
- Perform radiation experiments: Determine surface emissivity of a test plane and Stefan-Boltzmann's constant and compare with theoretical values.
- Estimate heat transfer coefficients in condensation, boiling and effectiveness of heat pipe.

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M.Tech. TE I Year II Sem **L/P/C**
-/3/2

(R22D2184) COMPUTATIONAL FLUID DYNAMICS LABORATORY

Course Objectives:

- Determining the aerodynamic forces like mainly lift and drag.
- Familiarize the usage of CFD software package.
- Model the heat transfer problems where fluid flows are present in CFD software package such as simulation software.
- Analyze the thermal systems under different flow conditions such as turbulent flow etc.
- Correlating the results obtained using different software with theoretical knowledge.

LIST OF EXPERIMENTS:

1. Solution for the one-dimensional wave equations using explicit method of lax using finite difference method (code development)
2. Solution for the one-dimensional heat conduction equation using explicit method using finite difference method (code development)
3. Numerical simulation of Flat plate boundary layer using FEM software
4. Numerical simulation of Laminar flow through pipe using FEM software
5. Numerical simulation of Flow past cylinder using FEM software
6. Numerical simulation of flow through nozzle using FEM software
7. Numerical simulation of combustion using FEM software
8. Simulation of Compressible flow in convergent divergent nozzle.
9. Simulation of compressible flow in a compressor.
10. Six degrees of freedom simulation F-16 model.
11. Measure the Lift and Drag forces experienced by an Unsymmetric/symmetric airfoil mounted on Load cells, at varying velocities and fixed angle of attack.

Note: Any 8 Experiments may be conducted.

Equipment Needed:

1. **Computers**: Core 2 duo processor with 1 GB RAM
2. **Soft wares:** Matlab or scilab and Ansys

Reference Books:

1. MATLAB an Introduction with Applications Fifth Edition AMOS GILAT by WILEY Publications
2. Programming in SCI lab by VINU V DAS New Age International Publications
3. ANSYS FLUENT and CFX Tutorials

Course Outcomes:

- Students will demonstrate basic knowledge of Laplace Transform., Vector differentiation and differentiation Integration.
- Students will demonstrate an ability to identify and Model the problems of the field of CFD.
- Students will be able to apply the application of Mathematics in Fluid Dynamics.
- Solve higher order linear differential equation using appropriate techniques for modeling and analyzing heat transfer components.
- Perform numerical simulation of various flow using mechanical flow components.

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(R22DHS55) ENGLISH FOR RESEARCH PAPER WRITING
(Audit Course – II)

INTRODUCTION

Writing a research paper is a significant part of any academia. It is a substantial piece of academic writing in which the author does independent investigation into a topic and writes a description of the findings of that study. Research studies are important because these contribute to a scholar's knowledge and also provide solutions to the latest challenges. Writing forces one to think about what he believes and what he wants to communicate. Since good writing skills allow a learner to communicate his message with clarity, an extensive exposure on techniques of writing research paper proves to be an immense value to the students.

OBJECTIVES

- To enable the students to use linguistic structures to form well-organized texts in research contexts
- To improve the quality of a composition by using appropriate cohesive devices
- To enhance the mechanics of writing skills using correct grammar and vocabulary
- To equip learners with the strategies of error – free writing
- To Comprehend and employ the various forms of scholarly composition.

SYLLABUS

UNIT-I - Sentence Formation
Word order, structuring paragraphs, Breaking up long sentences

UNIT-II - Cohesive devices
Types of cohesive devices - Anaphoric reference, Cataphoric reference, Exophoric reference
Tense agreement

UNIT-III – Academic Vocabulary
Hedging, Transitions – Additive, Adversative, Causal, Sequential

UNIT-IV – Grammar for Research Papers
Active & Passive, Punctuation, Articles

UNIT-V – Academic writing
Removing redundancy, Avoiding ambiguity, Paraphrasing, Sample Abstracts for practice, Sample videos

*** Exercises apart from the text book shall also be referred for classroom tasks.**

REFERENCE BOOKS:

1. English for Writing Research Papers. Adrian Wallwork, edition II, Springer, 2016.
2. Handbook of Technical Writing. James H. Shelton, McGraw Hill, 1994
3. Writing the Research Paper, a handbook. 8th edition, Anthony C. Winkler, Jo Ray Metherell, Wadsworth, 2012

OUTCOMES:

Students will be able to:

- Write in a clear, coherent, and direct style appropriate for academic research
- Draft coherent and unified paragraphs with adequate supporting details.
- Develop the strategy to use lexical terms effectively.
- Adopt appropriate syntactic and semantic techniques
- Demonstrate analytical and inferencing skills.
- Comprehend and employ the various forms of scholarly composition.

II YEAR

I SEMESTER

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(R22D2116) FUELS & COMBUSTION
(PROGRAM ELECTIVE–V)

Course Objectives:

- Provide students with knowledge of fuel quantity and engine technology effects on emissions. Understand the combustion phenomena.
- Understand the concept of laminar and turbulent flame propagation. To give students the basic understanding of the thermodynamics of combustion process.
- To equip students with the knowledge of the important chemical reactions occurring in combustion engines their rates and control. .
- To study the flame structure of premixed and diffusion flames.
- Enabling them to know the use of different techniques for determination of thermal and transport properties of commercial fuels.

UNIT–I

Fuels: Detailed classification – Conventional and Unconventional Solid, Liquid, gaseous fuels, and nuclear fuels – Origin of Coal – Analysis of coal. Coal – Carbonization, Gasification, and liquefaction – Lignite: petroleum-based fuels – problems associated with very low calorific value gases: Coal Gas – Blast Furnace Gas Alcohols and Biogas.

UNIT–II

Principles of Combustion: Chemical composition – Flue gas analysis – dew point of products– Combustion stoichiometry. Chemical kinetics – Rate of reaction – Reaction order – Molecularity – Zeroth, first, second and third order reactions – complex reactions – chain reactions. Theories of reaction Kinetics – General oxidation behavior of HC's.

UNIT–III

Thermodynamics of Combustion: Enthalpy of formation – The heating value of fuel – Adiabatic flame Temperature – Equilibrium composition of gaseous mixtures.

UNIT–IV

Laminar and Turbulent Flames Propagation and Structure: Flame stability –Burning velocity of fuels – Measurement of burning velocity – factors affecting the burning velocity. Combustion of fuel, droplets, and sprays – Combustion systems – Pulverized fuel furnaces – fixed Entrained and Fluidised Bed Systems.

UNIT–V

Environmental Considerations: Air pollution – Effects on Environment, Human Health etc. Principal pollutants – Legislative Measures – Methods of Emission control.

Course Outcomes:

- Extend their knowledge of fuels and engines to different situations of engineering context and professional practice.

- Understand about different methods to reduce air pollution The flame temperature of commercial fuels burning in the combustion chambers of internal combustion engines
- The rate of chemical reactions and emission characteristics of hydrocarbon fuels used in power plants and transportation sector.
- The burning velocity of premixed flames and important combustion characteristics of diffusion flames.
- Thermodynamic and transport properties of fuels at elevated pressures and temperatures prevalent in the combustion chambers of actual engines

TEXTBOOKS:

1. Combustion Fundamentals / Roger A strehlow / Mc Graw Hill
2. Fuels and combustion / Sharma and Chander Mohan/ Tata Mc Graw Hill
3. Combustion Engineering and Fuel Technology / Shaha A.K./ Oxford and IBH.

REFERENCE BOOKS:

1. Combustion / Sarkar / Mc. Graw Hill.
2. An Introduction to Combustion / Stephen R. Turns/ Mc. Graw Hill International Edition.
3. Combustion Engineering / Gary L. Berman & Kenneth W. Ragland/ Mc. Graw Hill International Edition

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(R22D2117) CONVECTIVE HEAT TRANSFER
(PROGRAM ELECTIVE–V)

Course Objectives:

- Student learns the fundamental and advanced principles of forced and natural convection heat transfer processes.
- Student Analyze and solve laminar and forced convective heat transfer problems
- Student can use principles of convection heat transfer to estimate the heat dissipation from different channels
- Student will learn about the Combined Convection processes.
- Student able to learns the concept of Porous media challenges in the field of convective heat transfer.

UNIT-I :

Introduction to Forced, free & combined convection – convective heat transfer coefficient – Application of dimensional analysis to convection – Physical interpretation of dimensionless numbers. Equations of Convective Heat Transfer: Continuity, Navier-Strokes equation & energy equation for steady state flows – similarity – Equations for turbulent convective heat transfer – Boundary layer equations for laminar, turbulent flows – Boundary layer integral equations.

UNIT-II:

External Laminar Forced Convection: Similarity solution for flow over an isothermal plate– integral equation solutions – Numerical solutions – Viscous dissipation effects on flow over a flat plate. External Turbulent Flows: Analogy solutions for boundary layer flows – Integral equation solutions – Effects of dissipation on flow over a flat plate. Internal Laminar Flows: Fully developed laminar flow in pipe, plane duct & ducts with other cross sectional shapes – Pipe flow & plane duct flow with developing temperature field.

UNIT – III:

Natural Convection: Boussinesq approximation – Governing equations – Similarity – Boundary layer equations for free convective laminar flows – Numerical solution of boundary layer equations. Free Convective flows through a vertical channel across a rectangular enclosure – Horizontal enclosure – Turbulent natural convection.

UNIT – IV:

Combined Convection: Governing parameters & equations – laminar boundary layer flow over an isothermal vertical plate – combined convection over a horizontal plate – correlations for mixed convection – effect of boundary forces on turbulent flows – internal flows - internal mixed convective flows – Fully developed mixed convective flow in a vertical plane channel & in a horizontal duct.

UNIT - V:

Convective Heat Transfer through Porous Media: Area weighted velocity – Darcy flow model – energy equation – boundary layer solutions for 2-D forced convection – Fully developed duct flow – Natural convection in porous media – filled enclosures – stability of horizontal porous layers.

TEXT BOOKS:

1. Introduction to Convective Heat Transfer Analysis/ Patrick H. Oosthuigen & David Naylor/McGraw Hill
2. Convective Heat & Mass Transfer /Kays & Crawford/TMH
3. Heat & Mass Transfer – D.S. Kumar
4. Heat Transfer – Necati Ozisik ,TMH

REFERENCE BOOKS :

1. Bejan, A., Convection Heat Transfer, John Willey and Sons, New York, 2001.
2. Louis, C. Burmeister, Convective Heat Transfer, John Willey and Sons, New York, 2003.
3. Kays, W.M. and Crawford, M. E., Convective Heat and Mass Transfer, McGraw Hill, New York, 2001.
4. Fundamentals of Heat & Mass Transfer – Incroera Dewitt , Jhon Wiley
5. Heat Transfer – P.K. Nag, TMH
6. Principle of Heat Transfer – Frank Kreith & Mark.Bohn.

COURSE OUTCOMES:

- Understand the fundamental and advanced principles of forced and natural convection heat transfer processes.
- Formulate and solve convective heat transfer problems.
- Apply the principles of convective heat transfer to estimate the heat dissipation from devices
- Evaluate the energy requirements for operating a flow system with heat transfer.
- Relate to the current challenges in the field of convective heat transfer through Porous media.

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(R22D2118) ADVANCED MATERIALS FOR THERMAL SYSTEMS (PROGRAM ELECTIVE–V)

Course objectives: The course is intended to

- To identify, design and develop new materials and composites for compact thermal energy storage.
- To develop multi-scale numerical models, describing and predicting the performance of new materials in thermal storage systems for nuclear power plants.
- To develop and demonstrate novel compact thermal energy storage systems employing the advanced materials.
- To assess the impact of new materials on the performance of thermal energy storage in the different applications considered.
- To characterize new storage materials reliably and reproducibly and to improve the performance, stability, and cost-effectiveness of new storage materials.

UNIT – I:

Review of 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 behavior 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. 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 ruptur, and stress corrosion, evaluation of creep behavior.

UNIT-II:

Nuclear Power Plant and Their Materials: Nuclear reactor, pressurized reactor, breeder reactor. Materials for fuel, control rods, coolant, moderator, shielding. Effects of Radiation on Materials Properties: Effects of α,β, γ rays on creep, fatigue, tensile, and other properties of metals, alloys, ceramics, polymers, rubbers etc. Effects on electrical, electronic and magnetic behavior of materials, Effects on crystal structure, grain size etc.

UNIT-III:

Materials in Fuel cells and Solar Cells Electrocatalyst materials for low temperature fuel cells, Conductive membranes for low-temperature fuel cells, Materials for high temperature

fuel cells, silicon, quantum dots for solar energy, nanomaterials for solar thermal energy and photovoltaic.

UNIT-IV:

Materials in Thermal Power Generation Super alloys, steels, ceramics, TBC, hydrogen membrane materials, sensor and sensor materials, biomass, coal, fly ash,etc.

UNIT-V:

Energy storage-Artificial photosynthesis/solar to fuels, CO_2 separation and utilization, Safer nuclear waste disposal, biofuels production, biological fuel cell technologies, reduction of energy use in manufacturing processes, Improved grid technologies, sustainable energy economy.

TEXT BOOKS/ REFERENCE BOOKS:

1. Introduction to Nuclear Science, Bryan, J. C., CRC Press.
2. Fundamentals of Radiation Materials Science, G.S. Was, Springe
3. Nuclear Reactor Materials and Applications, B.M. Ma, Van Nostrand Reinhold Company.
4. Nuclear Reactor Materials, C.O. Smith, Addison-Wesley Publishing Company.
5. Fundamentals Aspects of Nuclear Fuel Elements, D.R. Olander.
6. Structural Materials in Nuclear Power Systems, J. T. A. Roberts, Plenum Press.
7. Handbook of Fuel Cells, Wolf Vielstich, Arnold Lamm, Hubert A. Gasteiger, and Harumi Yokokawa, John Wiley and Sons, Inc.
8. Advanced power plant materials, design and technology, Edited by D Roddy, Woodhead Publishing Series in Energy No. 5 and CRC Press.

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

- Successfully apply advanced concepts of materials engineering to the analysis, design and development of materials, devices, systems, and processes to meet desired needs of society professionally and ethically.
- Be continuously aware of contemporary issues and research opportunities/challenges in the field of materials engineering as related to energy and sustainability and engage in life-long learning in the field and in the fundamentals of other related disciplines.
- Use advanced materials characterization techniques, skills, and modern scientific and engineering tools.
- Understand new storage technologies and their utilization.

OPEN ELECTIVE

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(R22DME51) NON-CONVENTIONAL ENERGY SOURCES
(OPEN ELECTIVE)

Course Objectives:

- To explain the concept of various forms of renewable energy.
- To outline division aspects and utilization of renewable energy sources for both domestics and industrial applications.
- To impart the knowledge of basics of different non conventional types of power generation & power plants in detail.
- Understanding the need and role of Non-Conventional Energy sources particularly when the conventional sources are scarce in nature.
- Student learn different sources and conversion techniques for better society

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 reaction, P-P cycle, Carbon cycle, Deuterium cycle, Condition for controlled fusion, Fuel cells and photovoltaic, Thermionic and Thermoelectric generation and MHD generator.

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

UNIT-IV

Bioenergy: Biomass energy sources. Plant productivity, Biomass wastes, aerobic and anaerobic bioconversion processes, Raw material and properties of bio-gas, Bio-gas plant technology and status, the energetic 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.

Course Outcomes:

- Students get expertise in analyzing the environmental sources.
- Cost economics of using renewable energy sources compared to fossil fuel.
- Students get exposure on direct energy conversion systems.
- Student expertise the need and role of Non-Conventional Energy sources
- Recognize the need and ability to engage in lifelong learning for further developments in this field

TEXTBOOKS:

1. Non-conventional Energy Sources / GD Rai/Khanna publications.
2. Non-Conventional Energy Sources and Utilisation (Energy Engineering)/ R K Rajput / S.Chand.
3. Renewable Energy Sources /Twidell & Weir/Taylor and Francis/ 2nd special Indian edition.

REFERENCE BOOKS:

1. Renewable Energy Resources- Basic Principles and Applications/ G.N.Tiwari and M.K.Ghosal/ Narosa Publications.
2. Renewable Energy Resources/ John Twidell & Tony Weir/Taylor & Francis/2nd edition.
3. Non-Conventional Energy / K.Mittal/ Wheeler.

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M.Tech TE II Year I Sem **L/P/C**
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(R22DME52) INDUSTRIAL SAFETY
(OPEN ELECTIVE)

Course Objectives:

- Students will be able to recognize and evaluate occupational safety and health hazards in the workplace
- To explain the concept of various industrial safety methods. To outline division aspects measurements of safety performance.
- Able to analyze the effects of workplace exposures, injuries and illnesses, fatalities
- To determine appropriate hazard controls following the hierarchy of controls
- Understand new storage technologies and their utilization.

UNIT-I:

Importance of Safety, health and environment. Health safety and environmental policy, fundamentals of safety, classification of accidents, Managements responsibility, objectives of safety management, National safety council, Employees state insurance act 1948, approaches to prevent accidents, principles of safety management, safety organization, safety auditing, maintenance of safety, measurements of safety performance, industrial noise and noise control, Industrial Psychology, Industrial accidents and prevention. Introduction to OSHAS 18001 AND OSHA.

UNIT II:

Process safety management (P.S.M) as per OSHA, legal aspects of safety, safety with respect to plant and machinery, the explosive act 1884, Petroleum act 1934, personal protective equipment, classification of hazards, protection of respiratory system, work permit system, hazards in refineries and process plants, safety in process plants, pollution in some typical process industry.

UNIT III:

Safe working practices, housekeeping, safe working environment, safety device and tools, precaution in use of ladders, safety instruction during crane operation, safety instruction for welding, burning and cutting and gas welding equipment, electrical safety, case studies, safety in use of electricity, electric shock phenomena, Occurrence of electric shock, medical analysis of electric shock and its effect, safety procedures in electric plants, installation of earthing system,

UNIT IV:

Safety in hazardous area, hazard in industrial zones, classification of industrial Enclosures for gases and vapors. Mechanical, Chemical, Environmental and Radiation hazards, Machine guards and safety devices, slings, load limits, lifting tackles and lifting equipment, hydrostatic test, Chemical hazards, industrial toxicology, toxic chemicals and its harmful

effects on humans, factors influencing the effect of toxic materials, Units of concentration, control measure, environmental hazards, devices for measuring radiation, safety analysis and risk analysis, risk management, First aid, Safety measures to avoid occupational diseases.

UNIT V

Factories act – 1948 Statutory authorities – inspecting staff, health, safety, provisions relating to hazardous processes, welfare, working hours, employment of young persons – special provisions – penalties and procedures- Indian Boiler Act 1923, static and mobile pressure vessel rules (SMPV), motor vehicle rules, mines act 1952, workman compensation act, rules – electricity act and rules.

Course Outcome:

- Evaluate workplace to determine the existence of occupational safety and health hazards
- Identify relevant regulatory and national consensus standards along with best practices that are applicable
- Educate students about how to reduce work place hazards and to encourage the standard of Safety, Health & Environment programme , so as to aim 0% accidents and 100% safety in different industries in which Industrial Safety plays an important role.
- Select appropriate control methodologies based on the hierarchy of controls
- Understanding of safety laws and acts worldwide.

Text Books:

1. Industrial safety management By: L.M. Deshmukh Publishers: Tata Mcgraw Hill ,New Delhi Year: 2006 Edition: First
2. The Factories Act 1948, Madras Book Agency, Chennai, 2000

References:

1. Industrial safety health and environment Management system By: R.K. Jain & Sunil S. Rao Publishers: Khanna Publishers Year: 2008 Edition: Second
2. The Indian boilers act 1923, Commercial Law Publishers (India) Pvt.Ltd., Allahabad.
3. ”Accident prevention manual for industrial operations”, N.S.C.,Chicago, 1982.
4. Industrial Safety and Environment by Amit Gupta
5. “Safety in Industry” N.V. Krishnan Jaico Publishery House, 1996.

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(R22DME53) OPERATIONS RESEARCH
(OPEN ELECTIVE)

Course Objectives:

- To familiarize the students with the use of practice oriented mathematical applications for optimization functions in an organization.
- To familiarize the students with various tools of optimization, probability, statistics and simulation,
- To applicable in particular scenarios in industry for better management of various resources.
- To develop a report that describes the model and the solving technique, analyse the results and propose recommendations in language.
- Understandable to the decision-making processes in Management Engineering.

UNIT–I

Introduction: Development – Definition– Characteristics and Phases – Types of models – operation Research models– applications.

Allocation: Linear Programming Problem Formulation – Graphical solution – Simplex method –Artificial variables techniques -Two–phase method, Big-M method.

UNIT–II

Transportation Problem – Formulation – Optimal solution, unbalanced transportation problem –Degeneracy. Assignment problem – Formulation – Optimal solution - Variants of Assignment Problem-Traveling Salesman problem.

Sequencing – Introduction – Flow **–**Shop sequencing – n jobs through two machines – n jobs through three machines – Job shop sequencing – two jobs through 'm' machines.

UNIT–III

Replacement: Introduction – Replacement of items that deteriorate with time – when money value is not counted and counted – Replacement of items that fail completely, group replacement.

Theory of Games: Introduction – Minimax (maximin) – Criterion and optimal strategy – Solution of games with saddle points – Rectangular games without saddle points – 2 X 2 games – dominance principle – m X 2 & 2 X n games -graphical method.

UNIT–IV

Waiting Lines: Introduction – Single Channel – Poisson arrivals – exponential service times – with infinite population and finite population models– Multichannel – Poisson arrivals – exponential service times with infinite population single channel Poisson arrivals.

Inventory: Introduction – Single item – Deterministic models – Purchase inventory models with one price break and multiple price breaks – shortages are not allowed – Stochastic

models – demand may be discrete variable or continuous variable – Instantaneous production. Instantaneous demand and continuous demand and no set up cost.

UNIT–V

Dynamic Programming: Introduction – Bellman's Principle of optimality – Applications of dynamic programming- capital budgeting problem – shortest path problem – linear programming problem.

Simulation: Definition – Types of simulation models – phases of simulation– applications of simulation – Inventory and Queuing problems – Advantages and Disadvantages – Simulation Languages.

Course Outcomes:

- Student will be able to illustrate the need to optimally utilize the resources in various types of industries.
- Apply and analyze mathematical optimization functions to various applications.
- Demonstrate cost effective strategies in various applications in industry.
- Student will be able to implement these Techniques in real Life.
- Student can use this mathematical software to solve the proposed models.

TEXT BOOKS:

1. Operations Research / S.D.Sharma-Kedarnath
2. Introduction to O.R/Hiller & Libermann (TMH).
3. Introduction to O.R /Taha/PHI

REFERENCE BOOKS:

1. Operations Research /A.M.Natarajan,P.Balasubramani,A. Tamilarasi/Pearson Education.
2. Operations Research / R.Pannerselvam,PHI Publications.
3. Operation Research /J.K.Sharma/MacMilan.

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M.Tech TE II Year I Sem **L/P/C**
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(R22DHS51) BUSINESS ANALYTICS
(OPEN ELECTIVE)

Course Objectives:

- To understand the importance of ever-increasing volume, variety and velocity of data in organization and application of data analytical tools for decision making.
- Students will demonstrate ethical reasoning skills, understand social, civic, and professional responsibilities and aspire to add value to society.
- Students will effectively communicate using business specific terminology in written and verbal form.
- Students will utilize interpersonal and leadership skills to be highly effective business managers and leaders.
- Students will have a strategic understanding of business analytics.

Unit-I: Introduction to Business Analytics: Importance, Scope, Evolution, Classification, and Application; Data Structure-Visualization of Data, Data Architecture, Measurement Scale; Decision Models-Classification, Structure of Decision Models; Data Structure and Data View-Understanding of data, exploring data using pivot tables.

Unit-II: Descriptive Analytics: Descriptive Statistical Measures–Population and samples, Measures of location, Measures of Dispersion, Measures of variability, measures of Association. Probability distribution and Data Modeling – Discrete Probability distribution, Continuous Probability distribution, Random sampling from Probability Distribution, Data Modeling and Distribution fitting.

Unit-III: Predictive Analytics: Karl Pearson Correlation Techniques -Multiple Correlation-Spearman's Rank correlation-Simple and Multiple regression-Regression by the method of least squares –Building good regression models –Regression with categorical independent variables --Linear Discriminant Analysis-One way and Two Way ANOVA

Unit-IV: Data Mining: Scope of Data Mining, Data Exploration and Reduction, Unsupervised learning –cluster analysis, Association rules, Supervised learning-Partition Data, Classification Accuracy, prediction Accuracy, k-nearest neighbors, Classification and regression trees, Logistics Regression.

Unit-V: Simulation: Random Number Generation, Monte Carlo Simulation, What if Analysis, Verification and Validation, Advantages and Disadvantages of Simulation, Risk Analysis, Decision Tree Analysis.

Text Book/References Books

- James Evans, Business Analytics, 2e, Pearson.
- Camm, Cochran, Fry, Ohlmann, Anderson, Sweeney, Williams Essential of Business Analytics, Cengage Learning.

- Thomas Eri, Wajid Khattack & Paul Buhler: Big Data Fundamentals, Concepts, drivers and Techniques by Prentice Hall of India, New Delhi.
- Akil Maheswari: Big Data, Upskill ahead by Tata McGraw Hill, New Delhi.
- Seema Acharya & Subhashini Chellappan: Big Data and Analytics, Wiley Publications, New Delhi.
- S. Christian Albright, Wayne L. Winston: Business Analytics: Data Analysis & Decision Making, Cengage Learning

CourseOutcomes:

- Students will be able to understand Importance of Analytics.
- Students will be able to understand Understanding the analytical tools.
- Students will be able to understand Application of Analytical tools to solve business problems.
- Students will demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.
- Analyze and evaluate appropriate business strategies, practices, and theories that inform and guide organizations to ensure sustainability.

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(R22DCS51) SCRIPTING LANGUAGES
(OPEN ELECTIVE)

Course Objectives:

- Motivation for and applications of scripting.
- Difference between scripting languages and non- scripting languages.
- Types of scripting languages.
- Scripting languages such as PERL, PHP,TCL/TK, python and BASH.
- Creation of programs in the Linux environment.

UNIT I

Introduction to PERL and Scripting Scripts and Programs, Origin of Scripting , Scripting Today, Characteristics of Scripting Languages, Web Scripting, and the universe of Scripting Languages. PERL- Names and Values, Variables, Scalar Expressions, Control Structures, arrays, list, hashes, strings, pattern and regular expressions, subroutines, advance per l - finer points of looping, pack and unpack, file system, eval, data structures, packages, modules, objects, interfacing to the operating system, Creating Internet ware applications, Dirty Hands Internet Programming, security Issues.

UNIT II

PHP Basics- Features, Embedding PHP Code in your Web pages, Outputting the data to the browser, Data types, Variables, Constants, expressions, string interpolation, control structures, Function, Creating a Function, Function Libraries, Arrays, strings and Regular Expressions.

UNIT III

Advanced PHP Programming Php and Web Forms, Files, PHP Authentication and Methodologies -Hard Coded, File Based, Database Based, IP Based, Login Administration, Uploading Files with PHP, Sending Email using PHP, PHP Encryption Functions, the Mcrypt package, Building Web sites for the World – Translating Websites- Updating Web sites Scripts, Creating the Localization Repository, Translating Files, text, Generate Binary Files, Set the desired language within your scripts, Localizing Dates, Numbers and Times.

UNIT IV

TCL Structure, syntax, Variables and Data in TCL, Control Flow, Data Structures, input/output, procedures, strings, patterns, files, Advance TCL- eval, source, exec and up level commands, Name spaces, trapping errors, event driven programs, making applications internet aware, Nuts and Bolts Internet Programming, Security Issues, C Interface. Tk- Visual Tool Kits, Fundamental Concepts of Tk, Tk by example, Events and Binding, Perl-Tk.

UNIT V

Python Introduction to Python language, python-syntax, statements, functions, Built-in-functions and Methods, Modules in python, Exception Handling, Integrated Web Applications in Python – Building Small, Efficient Python Web Systems, Web Application Framework.

Course Outcomes:

- Ability to create and run scripts using PERL/TCl/Python/PHP in IC design flow.
- Be familiar with design issues of object-oriented and functional languages.
- Be familiar with language abstraction constructs of classes, interfaces, packages, and procedures.
- Be familiar with using functional languages.
- Ability to use Linux environment and write programs for automation of scripts in VLSI tool design flow.

TEXT BOOKS:

1. The World of Scripting Languages, David Barron, Wiley Publications.
2. Python Web Programming, Steve Holden and David Beazley, New Riders Publications.
3. Beginning PHP and MySQL, 3rd Edition, Jason Gilmore, Apress Publications (Dreamtech)

REFERENCE BOOKS:

1. Open Source Web Development with LAMP using Linux, Apache, MySQL, Perl and PHP, J.Lee and B.Ware (Addison Wesley) Pearson Education.
2. Programming Python, M.Lutz, SPD.
3. PHP 6 Fast and Easy Web Development, Julie Meloni and Matt Telles, Cengage Learning Publications.
4. PHP 5.1,I.Bayross and S.Shah, The X Team, SPD.
5. Core Python Programming, Chun, Pearson Education.
6. Guide to Programming with Python, M.Dawson, Cengage Learning.
7. Perl by Example, E.Quigley, Pearson Education.
8. Programming Perl, Larry Wall, T.Christiansen and J.Orwant, O'Reilly, SPD.
9. Tcl and the Tk Tool kit, Ousterhout, Pearson Education.
10. PHP and MySQL by Example, E.Quigley, Prentice Hall(Pearson).
11. Perl Power, J.P.Flynt, Cengage Learning.
12. PHP Programming solutions, V.Vaswani, TMH.

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(R22DAE51) MATHEMATICAL MODELING TECHNIQUES
(OPEN ELECTIVE)

Course Objectives

- The objective is to emphasize the importance of mathematical modeling of diverse engineering problems.
- Specifically aerospace problems will be discoursed to understand the need for numerical techniques
- To introduce optimization techniques into numerical problems to reduce problem data.
- Identify a problem and choose an appropriate mathematical model.
- Solve the problem using the appropriate technology if necessary.

UNIT-I

INTRODUCTION TO MODELING AND SINGULAR PERTURBATION METHODS: Definition of a model, Procedure of modeling: problem identification, model formulation, reduction, analysis, Computation, model validation, Choosing the model, Singular Perturbations: Elementary boundary layer theory, Matched asymptotic expansions, Inner layers, nonlinear oscillations

UNIT-II

VARIATIONAL PRINCIPLES AND RANDOM SYSTEMS: Variational calculus: Euler's equation, Integrals and missing variables, Constraints and Lagrange multipliers, Variational problems: Optics-Fermat's principle, Analytical mechanics: Hamilton's principle, Symmetry: Noether's theorem, Rigid body motion, Random systems: Random variables, Stochastic processes, Monte Carlo method

UNIT-III: **FINITE DIFFERENCES: ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS**

ODE: Numerical approximations, Runge-Kutta methods, Beyond Runge-Kutta, PDE: Hyperbolic equations-waves, Parabolic equations-diffusion, Elliptic equations-boundary values

CELLULAR AUTOMATA AND LATTICE GASES: Lattice gases and fluids, Cellular automata and computing

UNIT- IV

FUNCTION FITTING AND TRANSFORMS: Function fitting: Model estimation, Least squares, Linear least squares: Singular value decomposition, Non-linear least squares: Levenberg-Marquardt method, Estimation, Fisher information, and Cramer-Rao inequality, Transforms: Orthogonal transforms, Fourier transforms, Wavelets, Principal components

FUNCTION FITTING ARCHITECTURES: Polynomials: Pade approximants, Splines, Orthogonal functions, Radial basis functions, Over-fitting, Neural networks: Back propagation, Regularization

UNIT-V

OPTIMIZATION AND SEARCH: Multidimensional search, Local minima, Simulated annealing, Genetic algorithms

FILTERING AND STATE ESTIMATION: Matched filters, Wiener filters, Kalman filters, non-linearity and entrainment, Hidden Markov models

Course Outcomes:

- Student will be able to predict and develop a numerical framework to a problem of physical interest.
- Student will be able to choose different techniques to solve various problems of diverse engineering, more especially to aeronautics and aerospace.
- Student will also enable to choose better optimized solutions using different optimization techniques.
- Students will develop understanding of various mathematical concepts and modeling techniques required for successful application of mathematics.
- Student will be able to model data using the language and techniques of mathematics.

TEXT BOOK:

1. The Nature of Mathematical Modeling, Neil Gershenfeld, Cambridge University Press, 2006,ISBN 0-521-57095-6

REFERENCE BOOKS:

1. Mathematical Models in the Applied Sciences, A. C. Fowler, Cambridge University Press, 1997,ISBN 0-521-46140-5
2. A First Course in Mathematical Modeling, F. R. Giordano, M.D. Weir and W.P. Fox, 2003,Thomson, Brooks/Cole Publishers
3. Applied Numerical Modeling for Engineers, Donald De Cogan, Anne De Cogan, Oxford University Press, 1997

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(R22DEC51) EMBEDDED SYSTEMS PROGRAMMING (OPEN ELECTIVE)

Course Objectives

- To have knowledge about the basic programming of an embedded system.
- To provide in-depth knowledge about embedded processor, its hardware and software.
- To explain real time operating systems, inter-task communication and an embedded software development tool.
- To acquire knowledge about embedded processors and their applications.
- Test a real application of Embedded system on Board

UNIT-I

Embedded OS (Linux) Internals: Linux internals: Process Management, File Management, Memory Management, I/O Management. Overview of POSIX APIs, Threads – Creation, Cancellation, POSIX Threads Inter Process Communication - Semaphore, Pipes, FIFO, Shared Memory Kernel: Structure, Kernel Module Programming Schedulers and types of scheduling. Interfacing: Serial, Parallel Interrupt Handling Linux Device Drivers: Character, USB, Block & Network

UNIT-II

Open source RTOS: Basics of RTOS: Real-time concepts, Hard Real time and Soft Real-time, Differences between General Purpose OS & RTOS, Basic architecture of an RTOS, Scheduling Systems, Inter-process communication, Performance Matric in scheduling models, Interrupt management in RTOS environment, Memory management, File systems, I/O Systems, Advantage and disadvantage of RTOS.

UNIT-III

Open Source RTOS Issues: POSIX standards, RTOS Issues - Selecting a Real Time Operating System, RTOS comparative study. Converting a normal Linux kernel to real time kernel, Xenomai basics. Overview of Open source RTOS for Embedded systems (Free RTOS/ Chibios-RT) and application development.

UNIT-IV

VxWorks / Free RTOS: VxWorks/ Free RTOS Scheduling and Task Management - Realtime scheduling, Task Creation, Inter task Communication, Pipes, Semaphore, Message Queue, Signals, Sockets, Interrupts I/O Systems - General Architecture, Device Driver Studies, Driver Module explanation, Implementation of Device Driver for a peripheral

UNIT-V

Case study: Cross compilers, debugging Techniques, Creation of binaries & porting stages for Embedded Development board (Beagle Bone Black, Rpi or similar), Porting an Embedded OS/ RTOS to a target board ().Testing a real time application on the board

Course Outcomes

- Ability to understand the internal architecture and interfacing of different peripheral devices with Microcontrollers.
- Ability to port an Embedded OS/ RTOS to a target board.
- Foster ability to understand the design concept of embedded systems.
- Ability to integrate hardware and software for embedded applications systems.
- Foster ability to understand the design concept of embedded systems.

TEXT BOOKS:

1. Essential Linux Device Drivers, Venkateswaran Sreekrishnan
2. Writing Linux Device Drivers: A Guide with Exercises, J. Cooperstein
3. Real Time Concepts for Embedded Systems – Qing Li, Elsevier

REFERENCES:

1. Embedded Systems Architecture Programming and Design: Raj Kamal, Tata McGraw Hill
2. Embedded/Real Time Systems Concepts, Design and Programming Black Book, Prasad, KVK
3. Software Design for Real-Time Systems: Cooling, J E Proceedings of 17the IEEE Real-Time Systems Symposium December 4-6, 1996 Washington, DC: IEEE Computer Society
4. Real-time Systems – Jane Liu, PH 2000
5. Real-Time Systems Design and Analysis : An Engineer's Handbook: Laplante, Phillip A
6. Structured Development for Real - Time Systems V1 : Introduction and Tools: Ward, Paul T & Mellor, Stephen J
7. Structured Development for Real - Time Systems V2 : Essential Modeling Techniques: Ward, Paul T & Mellor, Stephen J
8. Structured Development for Real - Time Systems V3 : Implementation Modeling Techniques: Ward, Paul T & Mellor, Stephen J
9. Monitoring and Debugging of Distributed Real-Time Systems: TSAI, Jeffrey J P & Yang, J H
10. Embedded Software Primer: Simon, David E.
11. Embedded Systems Architecture Programming and Design: Raj Kamal, Tata McGraw Hill

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(R22D2185) DISSERTATION PHASE 1

DISSERTATION PHASE 1

The dissertation / project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study.

The dissertation should have the following

- Relevance to social needs of society
- Relevance to value addition to existing facilities in the institute
- Relevance to industry need
- Problems of national importance
- Research and development in various domain

The student should complete the following:

- Literature survey Problem Definition
- Motivation for study and Objectives
- Preliminary design / feasibility / modular approaches
- Implementation and Verification
- Report and presentation

II YEAR

II SEMESTER

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(R22D2186) DISSERTATION PHASE 2

Course Objectives:

- Student understand the project and should give the clear explanation about the project
- To provide the foundation of good programming skills by discussing key issues to the design of project.
- To be able to apply some of the techniques/principle's students have been taught.
- To enable the students to attend placements and be better performers in their future.
- To familiarize with the various techniques.

Course Outcomes:

- Understand the data requirements and collect data relevant to their research.
- Analyze data and interpret results.
- Develop research design for their topic of research.
- Follow the process related activity and testing techniques to work as team member.
- Implement different system calls for various file handling operations.

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(R22D2187) DISSERTATION PROJECT VIVA VOCE

Course Objectives:

- Student understand the project and should give the clear explanation about the project
- To provide the foundation of good programming skills by discussing key issues to the design of project.
- To be able to apply some of the techniques/principle's students have been taught.
- To enable the students to attend placements and be better performers in their future.
- To familiarize with the various techniques.

Course Outcomes:

- Understand the data requirements and collect data relevant to their research.
- Analyze data and interpret results.
- Develop research design for their topic of research.
- Follow the process related activity and testing techniques to work as team member.
- Implement different system calls for various file handling operations.