B.TECH. – MECHANICAL ENGINEERING COURSE STRUCTURE – R23
(Applicable from the academic year 2023-24 onwards)
HONOR COURSES

Course Code	Name of the Honor Course
23TEH1	Advanced Thermal Engineering
23TEH2	Advanced Fluid Mechanics
23TEH3	Advanced Heat Transfer
23TEH4	Power Plant Engineering
23TEH5	Hybrid Vehicles
23TEH6	Computational Fluid Dynamics
23TEH7	Advanced Thermal Engineering Lab
23TEH8	Advanced Heat Transfer Lab
23TEH9	Computational Fluid Dynamics Lab

23TEH1- ADVANCED THERMAL ENGINEERING

L	T	P	C
3	0	0	3

PRE-REQUISITES: Thermodynamics

COURSE EDUCATIONAL OBJECTIVE:

The main objective of this course is to provide the knowledge on internal combustion engines with emphasis on pollutants and their control strategies, heat release rate and cylinder pressure analysis. The focus is on explaining the possible utilization of alternate fuels and their performance. On the other hand, economic and environmental aspects of alternative fuels usage will be illustrated.

COURSE OUTCOMES: At the end of the course students will be able to

- **CO1:** Analyse the combustion phenomenon of IC Engines and also the performance parameters. **(Analyzing-L4)**
- **CO2:** Describe the modern developments in IC Engines. **(Understanding-L2)**
- **CO3:** Demonstrate the working of gas turbines and compressors. **(Understanding-L2)**
- **CO4:** Apply various techniques to generate power from solar energy. **(Applying-L3)**
- **CO5:** Evaluate the performance parameters of refrigeration systems. **(Analyzing-L4)**

UNIT-I

I.C Engines: Classification - Working principles of SI and CI engines, Valve and Port Timing Diagrams, Otto, diesel and dual cycles, its comparison, Measurement, Testing and Performance.

COMBUSTION IN SPARK-IGNITION ENGINES: Stages of combustion in SI Engine- Flame Front propagation-Factors influencing flame speed- Rate of pressure rise-Analysis of Cylinder Pressure data- Heat release analysis-Abnormal combustion- Effects of Knocking- Effect of various parameters on Knocking- SI Engine Combustion chambers.

COMBUSTION IN COMPRESSION-IGNITION ENGINES: Stages of combustion in CI Engine-Factors effecting Ignition delay- Detonation in CI Engine-Types of injection systems in Diesel engines- Combustion chambers in CI Engines- Analysis of Cylinder Pressure data- Heat release analysis.

UNIT-II

MODERN DEVELOPMENTS IN IC ENGINES: Lean burn engines, Ceramic and adiabatic engines, Working principle of dual fuel engines, Multi-fuel engines, Stratified charged engines, Wankel engine, Features of Rotary engine, Variable compression-ratio engines, Methods of obtaining variable compression-ratio, Surface-ignition engines, Free Piston engines, Homogeneous charge compression-ignition engines.

UNIT-III

GAS TURBINES: Introduction, Classification, working and application of Gas Turbines, Ideal and Actual Cycles; Effect of Inter cooling, Reheating, Regeneration on gas turbine performance.

COMPRESSORS: Reciprocating and Rotary Compressors Introduction, Classification, Reciprocating compressors –Single, double and multistage compressors working principle, Power requirement of reciprocating compressors, efficiencies, Rotary compressors, Axial flow and centrifugal compressors.

UNIT-IV

SOLAR ENERGY: Performance Analysis of Non-concentrating Solar Collectors, Useful Heat Output Of A Non-concentrating Solar Collector, Efficiency Of Non-concentrating Solar Collectors, Performance Analysis Of Concentrating Solar Collectors, Efficiency of Concentrating Solar Collectors, Performance Of A Line-Focus Concentrating Collector, Performance Of Point-Focus Concentrating Collectors, Solar Thermal Electrical Power Plants and its Performance Parabolic Trough Solar Power Plants, Solar Power Tower Power Plants, Parabolic Dish/Stirling Engine System, Compact Linear Fresnel Reflector, Integrated Solar Combined-Cycle System (ISCC).

UNIT-V

REFRIGERATION: Introduction-Necessity and applications, unit of refrigeration, Heat Engine, Refrigerator and Heat Pump-C.O.P and Types of Refrigeration. Simple Vapour Compression refrigeration cycle, P-h charts, Factors affecting performance of VCR cycle, Actual VCR cycle. Introduction-Multi stage or Compound Compression-Multi Evaporator system-Cascade System.

CRYOGENICS: Introduction, Joules Thomson effect, production of dry ice, liquefaction of Hydrogen, Liquefaction of helium, Linde system, Claude system & its analysis, application of cryogenics.

TEXT BOOKS

1. Thermal Engineering - Mahesh Rathore- McGraw Hill publishers
2. Heat Engineering /V.P Vasandani and D.S Kumar/Metropolitan Book Company, New Delhi

REFERENCES

1. John B. Heywood, Internal Combustion Engine Fundamentals, 3rd edition, McGraw-Hill series, 2008.
2. V.Ganesan, Internal Combustion Engines, 4th edition, Tata McGraw Hill Education Private Limited, 2013.
3. S.S. Thipse, Alternative Fuels- Concepts, Technologies and Developments, 2nd edition, Jaico Publishing House, 2010.
4. A Course in Refrigeration and Air conditioning / SC Arora & Domkundwar / Dhanpatrai.2012.

L	T	P	C
3	0	0	3

23TEH2- ADVANCED FLUID MECHANICS

PRE-REQUISITES: Fluid Mechanics

COURSE EDUCATIONAL OBJECTIVE:

The main objective of this course is to provide the knowledge on the advanced concepts of fluid mechanics and its applications.

COURSE OUTCOMES: At the end of the course students will be able to

- **CO1:** Describe the laminar flow of viscous and in compressible fluids with governing equations. **(Understanding-L2)**
- **CO2:** Apply the boundary layer concepts for solving complex fluid flow problems. **(Applying-L3)**
- **CO3:** Discuss the features of turbulence and compressible fluid flow. **(Understanding-L2)**
- **CO4:** Apply the gas dynamics concepts to solve the problems of air flow in nozzles. **(Applying-L3)**
- **CO5:** Describe the fluid flow problems with friction in ducts. **(Understanding-L2)**

UNIT-I

BASIC CONCEPTS: Continuum hypothesis – Eulerian and Lagrangian descriptions. Derivation of general differential equations – continuity momentum and energy of incompressible flow- Navier Stokes equation for Viscous Fluids (Rectangular Coordinate Systems)- Euler"s equations for ideal fluids- Bernoulli"s equations (one dimensional) – applications.

LAMINAR FLOW VISCOUS INCOMPRESSIBLE FLUIDS: Flow similarity – Reynolds number, flow between parallel flat plates, Couette-flow, plane Poiseuille flow, Hagen – Poiseuille flow.

UNIT-II

LAMINAR BOUNDARY LAYER: Boundary layer concept, Prandtl"s approximations, Blassius solution for a flat plate without pressure gradient – momentum integral equation – Von-Kerman integral relation – Pohlhausen method of obtaining approximate solutions. Displacements thickness, momentum thickness and energy thickness. Boundary layer separation and control. Kerman integral equation.

UNIT-III

INTRODUCTION TO TURBULENCE: Origin of turbulence, nature of turbulent flow – Reynolds equations and Reynolds stresses, velocity profile.

COMPRESSIBLE FLUID FLOW BASICS: Mach number, Flow pattern in compressible flow, classification of compressible flow, isentropic flow, stagnation properties.

UNIT-IV

GAS DYNAMICS: Compressible flow through duct and nozzles – area velocity relations. Flow through convergent and convergent divergent nozzles. Real nozzles flow at design conditions.

Introduction to normal compression shock – normal shock relations. Introduction to Fanno Raleigh equations.

UNIT-V

FLOW IN DUCTS WITH FRICTION: Fanno line, adiabatic constant area- Flow of perfect gas, chocking due to friction in constant area flow- Introduction to constant area flow with heat transfer (Raleigh line)

REFERENCE BOOKS

1. “Foundations of Fluid Mechanics”, Yuan S.W. Prentice Hall – Eastern economy edition, 1983.
2. “ Gas Dynamics”, Zucrwo M.J. and Hoffman J.D.Vol-I & Vol-II, John Wiley and Sons Inc. 1977.
3. “Fundamentals of Compressible Flow”, - Yahya S.M. Wiley Eastern.
4. “A Brief Introduction to Fluid Mechanics” Young, Munsen and Okiisyi, 2nd Edition, John Wiley, 2000.
5. “ Fluid Mechanics, Frank.M.White 5th Edn – McGraw Hill, 2005.
6. D. Rama Durgaiah. (Fluid Mechanics and Machinery –New Age Publishers
7. William F. Hughes & John A. Brighton -Fluid Dynamics Tata McGraw-Hill
8. Schlichting H – Boundary Layer Theory (Springer Publications).
9. Pai - An Introduction to Compressible Flow.
10. Shapiro - Dynamics & Theory and Dynamics of Compressible Fluid Flow.

23TEH3- ADVANCED HEAT TRANSFER

L	T	P	C
3	0	0	3

PRE-REQUISITES: Thermodynamics

COURSE EDUCATIONAL OBJECTIVE:

To transform the physics of heat conduction, convection and radiation problem into its equivalent mathematical model. Also to analyze the internal, external forced and natural convection problems, radiation exchange between the surfaces and concepts of LMTD and NTU in heat exchangers.

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

CO1: Develop the mathematical model by understanding the physics of heat conduction/convection /thermal radiation problem into its equivalent mathematical model. **(Applying-L3)**

CO2: Solve the internal external forced convection and natural convection problems using analytical methods. **(Applying-L3)**

CO3: Compute the heat transfer aspects in phase change processes. **(Applying-L3)**

CO4: Find radiant energy exchange in thermal radiation systems. **(Applying-L3)**

CO5: Determine the LMTD and NTU aspects in heat exchangers. **(Applying-L3)**

UNIT-I

STEADY STATE HEAT CONDUCTION: Review of basic concepts of conduction, convection and radiation, Initial and boundary conditions, Methods of formulation: lumped, differential and integral formulations.

TRANSIENT HEAT CONDUCTION: Formulation of transient heat conduction problems with time independent boundary conditions in different geometries and their analytical solutions: method of separation of variables, method of Laplace transforms. Differential formulation of steady two-dimensional heat conduction problems in different geometries and their analytical solutions, method of superposition.

UNIT-II

FORCED CONVECTION: External laminar forced convection for flow over a semi-infinite flat plate; Integral and similarity solutions for different thermal boundary conditions; viscous dissipation effects in laminar boundary layer flow over a semi-infinite flat plate, Internal laminar forced convection: exact solutions to solution for rectilinear flows, axisymmetric rectilinear flows, and axisymmetric torsional flows; Solution for fully developed flow through a pipe with different thermal boundary conditions, Flow in the thermal entrance region of a circular duct.

FREE CONVECTION: External laminar free convection: integral and similarity solutions for semi-infinite vertical plate with different thermal boundary conditions

UNIT-III

BOILING: Regimes of boiling processes – Calculations on Nucleate boiling, Critical Heat flux and Film boiling
CONDENSATION: Film wise and drop wise condensation –Nusselt's Theory of Condensation on a vertical plate - Film condensation on vertical and horizontal cylinders using empirical correlations.

UNIT-IV
RADIATION: Basic definitions, Radiant energy exchange between two differential area elements. Radiation shape factor: properties and algebra. Radiant energy exchange between two surfaces. Radiant energy exchange in enclosures: enclosures composed of black and diffuse-grey surfaces. Electrical network analogy. Radiation in participating media: Radiative heat transfer equation, Radiant energy exchange in presence of absorbing and transmitting media, radiant energy exchange in presence of transmitting, reflecting, and absorbing media and radiation shields.

UNIT-V
HEAT EXCHANGERS: Classification of heat exchangers – overall heat transfer Coefficient and fouling factor – Concepts of LMTD and NTU methods - Problems using LMTD and NTU methods.

TEXT BOOKS:

1. Myers, G.E., 1971, Analytical methods in conduction heat transfer, McGraw Hill, New York.
2. Kays, W. M. and Crawford, M. E., 2005, Convective Heat and Mass Transfer, 3rd ed., McGraw Hill.
3. Howell, J.R., Mengüc, M.P., Daun, K., and Siegel, R., 2020, Thermal radiation heat transfer, CRC press, New York.
4. Heat Transfer by J.P; HOLMAN, Tata McGraw-Hill
5. Heat Transfer by P.K.Nag, TMH

REFERENCES:

1. Fundamentals of Heat Transfer by Incropera& Dewitt, John Wiley
2. Fundamentals of Engineering, Heat& Mass Transfer by R.C.Sachdeva, New Age.
3. Fundamentals of Heat and Mass Transfer,5th Ed. / Frank P. Incropera/John Wiley
4. Sparrow, E.M., 2018, Radiation heat transfer, Routledge, New York.
5. Modest, M.F., and Mazumder, S., 2021, Radiative heat transfer, Academic press, New York.
6. Introduction to Heat Transfer/SK Som/PHI
7. Kakac, S. Yener, Y., and Pramuanjaroenkij. A., 2014, Convective Heat Transfer, 3rd ed., CRC Press

23TEH4- POWER PLANT ENGINEERING

L	T	P	C
3	0	0	3

PRE-REQUISITES:

COURSE EDUCATIONAL OBJECTIVE:

This course provides understanding of the power plant engineering fundamentals which includes the details of steam, hydro, gas nuclear, combined cycle power plants along with the economics of power generation and the environmental aspect of power generation are also being addressed in this course.

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

CO1: Describe the energy scenario, the energy generation sources and various circuitry systems in power plants. **(Understanding – L2)**

CO2: Illustrate the working of gas turbine and hydro power plants. **(Understanding – L2)**

CO3: Understand the principles of nuclear power plants. **(Understanding – L2)**

CO4: Comprehend the combined operations of different power plants and plant instrumentation and its control. **(Understanding – L2)**

CO5: Calculate the economics of power generation from various power plants, pollution issues from power plant systems. **(Applying – L3)**

UNIT – I

Introduction to the sources of energy – resources and development of power in India.

STEAM POWER PLANT: Plant layout, working of different circuits, fuel handling equipment, types of coals, coal handling, choice of handling equipment, coal storage, ash handling systems. Combustion: properties of coal – overfeed and underfeed fuel beds, traveling grate stokers, spreader stokers, retort stokers, pulverized fuel burning system and its components, dust collectors, cooling towers and heat rejection.

UNIT – II

GAS TURBINE POWER PLANT: Introduction – classification, construction – layout with auxiliaries. Cogeneration of Power and Process heat. Waste heat recovery systems.

HYDRO ELECTRIC POWER PLANT: Classification – typical layouts – plant auxiliaries – plant operation pumped storage plants.

UNIT – III

NUCLEAR POWER PLANT: Nuclear fuel – breeding and fertile materials – nuclear reactor – reactor operation.

TYPES OF REACTORS: Pressurized water reactor, boiling water reactor, sodium, graphite reactor, fast breeder reactor, homogeneous reactor, gas cooled reactor, radiation hazards and shielding – radioactive waste disposal.

UNIT – IV

COMBINED OPERATIONS OF DIFFERENT POWER PLANTS: Introduction, advantages of combined working, load division between power stations, storage type hydro electric plant in combination with steam plant, run of river plant in combination with steam plant, pump storage plant in combination with steam or nuclear power plant, co-ordination of hydro electric and gas turbine stations, Coordination of different types of power plants.

POWER PLANT INSTRUMENTATION AND CONTROL: Importance of measurement and instrumentation in power plant, measurement of water purity, gas analysis, O2 and CO2 measurements, measurement of smoke and dust, measurement of moisture in carbon dioxide circuit.

UNIT – V

POWER PLANT ECONOMICS:

Capital cost, investment of fixed charges, operating costs, general arrangement of power distribution, load curves, load duration curve, definitions of connected load, maximum demand, demand factor, average load, load factor, diversity factor – related exercises.

ENVIRONMENT AND POLLUTION: Pollutants and pollution standards – methods of pollution control.

TEXT BOOKS:

1. A course in Power Plant Engineering /Arora and Domkundwar/Dhanpatrai & Co.
2. Power Plant Engineering /P.C.Sharma / S.K.Kataria Pub
3. Power Plant Engineering/Er. R. K. Rajput/ Laxmi Pub/2016

REFERENCES:

1. Power Plant Engineering: P.K.Nag/ II Edition /TMH.
2. Power station Engineering – ElWakil / McGrawHill.
3. An Introduction to Power Plant Technology / G.D. Rai/Khanna Publishers

L	T	P	C
3	0	0	3

23TEH5-HYBRID VEHICLES

PRE-REQUISITES:

COURSE EDUCATIONAL OBJECTIVE:

This course aims to provide a thorough understanding of various configurations of electric vehicles and hybrid vehicles, including their components and performance analysis. It also covers the properties and types of batteries used in these vehicles, and explains the working principles of different hybrid configurations. Furthermore, the course enables students to analyze recent advancements and technological developments in hybrid vehicle systems.

COURSE OUTCOMES*:* At the end of the course the students would be able to

- **CO1:** Discuss the fundamentals of EV system, vehicle mechanics and its performance. **(Understanding-L2)**
- **CO2:** Describe the electric vehicle modelling like rolling resistance, efficiency and general issue considerations. **(Understanding-L2) (Understanding-L2)**
- **CO3:** Learn about the introduction of batteries related to Electric Vehicles, Electric Vehicles testing and its performance. **(Understanding-L2)**
- **CO4:** Illustrate the hybrid vehicles. **(Understanding-L2)**
- **CO5:** Understand the advancements in hybrid vehicles. **(Understanding-L2)**

UNIT – I: INTRODUCTION TO ELECTRIC VEHICLES

Sustainable transportation, EV system, EV Advantages, Vehicle Mechanics, Performance of EVs, Electric Vehicle drive train, EV transmission configurations and components, Tractive effort in normal driving, Energy consumption, EV market, Types of Electric Vehicle in use today, Electric vehicles for the future.

UNIT – II: ELECTRIC VEHICLE MODELLING

Rolling resistance, Transmission efficiency, Consideration of vehicle mass, Tractive effort, Modelling Vehicle Acceleration, Modelling Electric Vehicle Range, Aerodynamic Considerations, Ideal Gear Box steady state Model, EV Motor Sizing, General issues in Design.

UNIT – III: BATTERIES

Introduction to Electric Vehicle battery, Electric Vehicle battery efficiency, Electric Vehicle battery capacity, Electric Vehicle battery charging, Electric Vehicle battery fast charging, Electric Vehicle battery, Electric Vehicle battery fast charging, Electric Vehicle battery testing and performance.

UNIT-IV: HYBRID ELECTRIC VEHICLES

HEV Fundamentals **-**Architectures of HEVs- Interdisciplinary Nature of HEVs - State of the Art of HEVs -Advantages and Disadvantages - Challenges and Key Technology of HEVs - Concept of

Hybridization of the Automobile-Plug-in Hybrid Electric Vehicles Design and Control Principles of Plug-In Hybrid Electric Vehicles - Fuel Cell Hybrid Electric Drive Train Design - HEV Applications for Military Vehicles.

UNIT - V: RECENT DEVELOPMENTS IN HYBRID VEHICLES

Battery Charger Topologies, Charging Power Levels, and Infrastructure for Plug-In Electric and Hybrid Vehicles, the Impact of Plug-in Hybrid Electric Vehicles on Distribution Networks -Sizing Ultra capacitors for Hybrid Electric Vehicles.

TEXT BOOKS:

1. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", CRC Press, 2004.
2. Ali Emadi, "Advanced Electrical Hybrid Vehicles" CRC Press, 2015, Taylor & FrancisGroup.
3. C. Mi, M. A. Masrur and D. W. Gao, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives",John Wiley & Sons, 2011.

REFERENCES:

1. T. Denton, "Electric and Hybrid Vehicles",Routledge,2016.
2. S. Onori, L. Serrao andG. Rizzoni, "Hybrid Electric Vehicles: Energy Management Strategies",Springer, 2015.

23TEH6- COMPUTATIONAL FLUID DYNAMICS

L	T	P	C
3	0	0	3

PRE-REQUISITES:

COURSE EDUCATIONAL OBJECTIVE:

To gain the knowledge on the fundamentals and governing equations of fluid dynamics, Develop understanding of numerical discretization methods, Train students in basic CFD modelling, meshing, and simulation using software tools in CFD to solve engineering problems.

COURSE OUTCOMES*:* At the end of the course the students would be able to

CO1: Understand the mathematical foundation of CFD. **(Understanding-L2)**
CO2: Apply numerical methods to solve fluid flow problems. **(Applying-L3)**
CO3: Model and discretize the basic fluid and heat transfer systems. **(Applying-L3)**
CO4: Develop the algorithms to solve the fluid flow problems. **(Applying-L3)**
CO5: Apply boundary conditions and mesh generation in CFD for solving simple engineering applications. **(Applying-L3)**

UNIT-I

INTRODUCTION TO CFD: Importance of CFD in engineering, Scope and applications in industry, CFD vs. experimental and analytical methods, Overview of CFD software tools, Finite difference method, finite volume method, finite element method, governing equations and boundary conditions. Derivation of finite difference equations.

UNIT-II

GOVERNING EQUATIONS OF FLUID FLOW: Conservation laws: mass, momentum, and energy, Navier-Stokes equations, Classification of partial differential equations (PDEs): elliptic, parabolic, hyperbolic, Initial and boundary conditions, multi-step methods in hyperbolic, nonlinear problems, second order one-dimensional wave equations. Explicit and implicit schemes, Runge-Kutta method.

UNIT-III

DISCRETIZATION TECHNIQUES: Finite Difference Method (FDM): basic concepts, Forward, backward, and central difference schemes, Formulations of incompressible viscous flows by finite difference methods, pressure correction methods, Finite Volume Method (FVM - formulations for two and three-dimensional problems Finite Element Method (FEM) - Standard Galerkin's Methods, Transient Problems – Generalized Galerkin's Methods, Example Problems. brief introduction, Stability, consistency, and convergence

UNIT-IV

SOLUTION METHODS: Solution algorithms for steady and unsteady problems, Iterative solvers (Jacobi, Gauss-Seidel, SOR), SIMPLE and SIMPLER algorithms for pressure-velocity coupling, Grid independence and error analysis.

UNIT-V

MESH GENERATION AND BOUNDARY CONDITIONS: Structured and unstructured meshes, Grid quality and refinement, Boundary condition types: inlet, outlet, wall, symmetry, periodic, Best practices in mesh generation, Case studies in internal and external flows, Heat transfer modeling using CFD

TEXTBOOKS:

1. Computational Fluid Dynamics: The Basics with Applications – John D. Anderson
2. An Introduction to Computational Fluid Dynamics: The Finite Volume Method – H.K. Versteeg and W. Malalasekera
3. Computational fluid dynamics, T. J. Chung, Cambridge University press, 2002.

REFERENCE BOOKS:

- Numerical Heat Transfer and Fluid Flow – S.V. Patankar
- Fundamentals of Computational Fluid Dynamics – Tapan K. Sengupta
- CFD software manuals and user guides (e.g., ANSYS Fluent, OpenFOAM)

23TEH7 -ADVANCED THERMAL ENGINEERING LAB

L	T	P	C
0	0	3	1.5

PRE-REQUISITES:

COURSE EDUCATIONAL OBJECTIVE:

Advanced Thermal Engineering lab is mainly focused to make the graduates to acquire the knowledge on engine testing and exhaust emission analysis, solar thermal systems parabolic trough collector, and solar PV systems and its performance measurements.

COURSE OUTCOMES*:* At the end of the course the students would be able to

CO1: Determine the performance and emission parameters of internal combustion engines. **(Applying-L3)**

CO2: Estimate the performance characteristics of solar PV system. **(Applying-L3)**

CO3: Evaluate the performance parameters of Refrigeration system. **(Applying-L3)**

CO4: Analyse the characteristics of solar parabolic trough collector. **(Applying-L3)**

LIST OF EXPERIMENTS

1. Performance Test on 4 stroke diesel engine using diesel and biofuel
2. Measurement of exhaust emissions of diesel engine
3. To evaluate the performance of a solar parabolic trough system under different atmospheric and design parameters with water and oil used as working fluids.
4. Performance Test on Variable Compression Ratio single cylinder 4-Stroke diesel Engine By using Eddy Current Dynamometer
5. Performance characteristics of solar parabolic concentrator test
6. Study of IV characteristics of solar radiation energy
7. Performance Test on Reciprocating Air – Compressor.
8. Performance analysis of solar flat plate collector test
9. COP estimation of vapour compression refrigeration system
10. Performance analysis of Air conditioning unit

REFERENCES:

Advanced Thermal engineering lab manual

23TEH8- ADVANCED HEAT TRANSFER LAB

L	T	P	C
0	0	3	1.5

PRE-REQUISITES: Thermodynamics, Thermal Engineering

COURSE EDUCATIONAL OBJECTIVE:

The objective of this laboratory course is to gain hands on experience on the modes of heat transfer in various heat transfer equipment's used for different applications by conducting experiments.

COURSE OUTCOMES: At the end of the course students will be able to

- **CO1** Estimate the heat transfer performance in thermal systems. **(Applying-L3)**
- **CO2** Determine the value of heat transfer coefficient from convection apparatus. **(Applying-L3)**
- **CO3** Compare the LMTD and NTU parameters in multi-pass heat exchangers. **(Analyzing-L4).**
- **CO4** Compute the value of heat transfer coefficients in free and forced convection using CAE Software tools. **(Applying-L3)**

CORE EXPERIMENTS

1. Boiling Heat Transfer and Critical Heat Flux
2. Heat transfer in convection apparatus.
3. Transient Heat Conduction in Composite Walls
4. Microscale or Nanofluid Heat Transfer
5. Multipass heat exchangers

SIMULATION EXPERIMENTS

1. Conduction through Composite Walls using ANSYS
2. Heat Transfer in Finned Surfaces using ANSYS
3. Convection in Internal Flows (Pipes/Channels) Using ANSYS
4. Cooling of Electronic Components using ANSYS
5. Thermal Stress Analysis in Solids using ANSYS

REFERENCES

- Lab Manuals

Data Hand Book:

- C.P. Kothandaraman and Subramanian, Heat and Mass Transfer Data Book, New Age International Publications, 7th Edition, Reprint 2012

NOTE: Heat and Mass Transfer Data Hand Book by C.P. Kothandaraman and Subramanian- New Age Publications is to be allowed in Examination.

23TEH9-COMPUTATIONAL FLUID DYNAMICS LAB

L	T	P	C
0	0	3	1.5

PRE-REQUISITES: Thermodynamics

COURSE EDUCATIONAL OBJECTIVE:

To solve the problems of fluid flow and heat transfer and build up the skills in the actual implementation of CFD methods for 1D and 2D heat conduction and convection problems and acquire skills in thermal analysis of the same.

COURSE OUTCOMES*:* At the end of the course the students would be able to

CO1	Develop codes for solution of algebraic and differential equations. **(Analyzing-L4)**
CO2	Develop skills in the actual implementation of CFD methods with their own codes. **(Analyzing-L4)**
CO3	Analyze real-life engineering applications with the help of CFD. **(Analyzing-L4)**
CO4	Design thermal engineering equipment using CFD. **(Analyzing-L4)**
CO5	Analyze and validate output of written codes with analytical solution. **(Analyzing-L4)**

LIST OF EXPERIMENTS:

1. Steady State heat transfer analysis through circular fins.
2. Steady State heat transfer analysis of a heat sink.
3. Steady State thermal analysis of a steel bar.
4. Steady State thermal analysis of a cylinder.
5. Steady State heat transfer analysis through composite slab.
6. Transient thermal analysis of convection of bar in air.
7. A turbulent fluid flow and heat transfer problem in a mixing elbow using Ansys fluent.
8. Fluid flow analysis of a radiator using Ansys fluent.
9. Fluid flow fluent analysis of a helical coil.
10. Fluid flow fluent analysis of two phase flow in a horizontal pipe.
11. Analysis of water flow in converging pipe using Ansys fluent.
12. Analysis of two dimensional laminar flow using Ansys fluent.

REFERENCES: CFD Lab Manual