R .K.D.F. UNIVERSITY, BHOPAL
M.TECH (THERMAL ENGINEERING)
First Year
Semester – I

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
Thermal	**Advanced Mathematics**	**METH-1001**	**3L-1T-0P**	**4**

Course Outcomes:- At the end of the course, the student will be able to
CO1-Understand the basic principles of sets and operations in sets.
CO2-Apply counting principles to determine probabilities.
CO3-Demonstrate different traversal methods for trees and graphs.
CO4-Write model problems in computer science using trees and graphs.

UNIT I

Solution of Partial Differential Equation (PDE) by separation of variable method, numerical Solution of PDE (Laplace, Poisson's, Parabola) using finite difference methods, Elementary Properties of FT, DFT, WFT, Wavelet transform, Haar transform.

UNIT II

Probability, compound probability and discrete random variable.Binomial, Normal, Poisson's distribution. Sampling distribution, elementary concept of estimation and theory of hypothesis, recurred relations.

UNIT III

Stochastic process, Markov process transition probability transition probability matrix, just and higher order Markov process, Markov chain. Queuing system, transient and steady state, traffic intensity, distribution queuing system, concepts of queuing models (M/M/1: Infinity/Infinity/FC FS), (M/M/1: N/Infinity/FC FS), (M/M/S: Infinity/Infinity/FC FS)

UNIT IV

Operations of fuzzy sets, fuzzy arithmetic & relations, fuzzy relations equations, fuzzy logics. MATLAB introduction, programming in MATLAB scripts, functions and their application.

UNIT V

Introduction and definition of reliability, derivation of reliability functions, Failure rate, Hazard Rate, mean + time future & their relations, concepts of fault tolerant analysis, Elementary idea about decision theory and goal programming.

Reference Books:

1. Higher Engineering Mathematics by B.V. Ramana, Tata Mc Hill.
2. Advance Engineering Mathematics by Ervin Kreszig, Wiley EastenEdd.
3. Applied Numerical Methods with MATLAB by Steven C Chapra, Tata McGraw Hill.
4. Introductory Methods of Numerical Analysis by S.S. Shastry.
5. Introduction of Numerical Analysis by Forberg.
6. Numerical Solution of Differential Equation by M.K. Jain
7. Numerical Mathematical Analysis by James B. Scarborogh.
8. Fourier Transforms by J.N. Sheddon.
9. Fuzzy Logic in Engineering by T.J. Ross.
10. Fuzzy Sets Theory & its Applications by H.J. Zimmersoms.

R.K.D.F. UNIVERSITY, BHOPAL
M.TECH THERMAL ENGINEERING

First Year

Semester – I

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
Thermal	**Advanced Thermodynamics**	**METH-1002**	**3L-1T-0P**	**4**

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

CO1:-To apply the knowledge of mathematics, science and engineering fundamentals to model the energy conversion phenomenon.

CO2:- To identify and formulate power production based on the fundamentals laws of thermal engineering.

CO3:- To investigate the effectiveness of energy conversion process in mechanical power generation for the benefit of mankind.

CO4:- To appreciate concepts learnt in fundamentals laws of thermodynamics from which learning ideas how to sustain in energy crisis and think beyond curriculum in the field of alternative and renewable sources of energy.

UNIT:-1

Law of Thermodynamics:-Equation of the first law of the thermodynamics, application of the first law to Flow & Non Flow system, reversible & irreversible processes with ideal and real gases. Statement of second law, Genralised Carnot cycle, Entropy & Exergy. Free energy and tied energy. Thermodynamics potential functions. Availability, Losses of maximum useful work, Nest's heat theorem.

UNI**T:-2**

Differential Equations of Thermodynamics:-Formulae of partial derivatives for internal energy. Differential equations for heat, enthalpy, entropy, free energy and isobaric potential. Equations of heat capacities.Application of general differential equations of thermodynamics. Thermal coefficients.

UNIT:-3

Changes in States of Gases at their Transferences:- Throttling process Joule Thomson effect. Temperature of braking. Mixtures of ideal & real gases. Mixing of flowing gases, mixing of gases at constant volume.

UNIT:-4

Equilibrium of Thermodynamic System:-Real substances & their properties. Triple point. Critical point. Temperature-Entropy, Enthalpy-Entropy charts. Equations of states for real gases Vanderwaal's equation of state.Clayperon equations. Gibbs phase rule. Law of corresponding states.

UNIT:-5

Fundamentals of Chemical Thermodynamics:-First law of thermodynamics in thermo chemistry. Heat effects of reaction, Hess's law. Kirchhoff's law, Chemical equilibrium. Bond energy.

Books:

1. Engineering Thermodynamics – Wan Wylen
2. Engineering Thermodynamics – G. Rogers & Y. Mayhow
3. Engineering Thermodynamics – Obert

4. Engineering Thermodynamics – Estop
5. Engineering Handbook 2nd Edition – Richard C. Dorf
6. Handbook of Applied Thermodynamics – David Palmer, CRC Press

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M.TECH (THERMAL ENGINEERING)
First Year
Semester – I

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
Thermal	**HEAT & MASS TRANSFER**	**METH-1003**	**3L-1T-0P**	**4**

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

CO1-Students will be able to comprehend the different mode of heat transfer.

CO2-Students are expected to formulate basic equations and Laws for heat transfer problems.

CO3-To understand the knowledge of mass transfer by applying principles of diffusion, mass transfer coefficients and inter phase mass transfer.

CO4-Applications of heat transfer principles to design and calculate performance of thermal systems related to one dimensional, steady state and transient state for conduction and convection heat transfer.

UNIT:-1

Transient Heat Conduction:- Newtonian heating/cooling sudden temperature changes in finitely thick slabs &semi-infinite, periodic heat flow: Graphical solution, analysis of thermocouple response.

UNIT:-2

Convection:- Convection heat transfer and boundary layers and development of their equations; approximation and special condition, boundary layer similarity equations, Reynold's analogy, similarity solutions for flow over flat plate convection heat transfer in flow through circular pipes, Laminar & Turbulent flows.

UNIT:-3

Heat Transfer by Radiation:- Heat radiation – a type of wave motion; concept of a perfect black body: plank's law of monochromatic radiation of a black body: Kirchhoff's law of radiation, Stefan – Boltzmann's law of total radiation. Emissivity and absorptivity of different bodies heat exchange between black surfaces; heat exchange between planes of different emissivity; heat exchange between and enclosed by and the enclosure.

UNIT:-4

Boiling and Condensation:-Boiling: Boiling heat transfer, nature of vaporization, nucleate pool boiling and empirical correlations for pool boiling heat transfer, factors affecting pool boiling film coefficients, high heat flux boiling. Condensation: Physical Mechanisms. Laminar film condensation on a vertical plate, turbulent film condensation, drops wise condensation.

UNIT:-5

Numerical Solution of Conduction problems and Mass Transfer:- Introduction, finite difference equations method of energy balance, finite difference formulation of unidirectional for Cartesian cylindrical coordinate of various kind of boundary conditions, heat conduction problems, numerical methods of solutions, numerical solution of transient heat diffusion problems. Mass Transfer: Convective mass transfer, equations for convective mass transfer, boundary layer mass transfer empirical correlations for convective mass transfer.

Text Book/References Books/ Websites:

1. Elements of Heat transfer by Bayazitouglu & Ozisik, McGraw-Hill Book Company.
2. Heat Transfer By J.P. Holman, McGraw-Hill International edition.
3. Schaum's outline of Heat Transfer by Pitts & Sisson McGraw-Hill International edition.
4. Principles of Heat Transfer by Frank Kreith, McGraw-Hill Book co.
5. Fundamentals of Momentum, Heat and Mass Transfer by James R.Welty; John Wiley & Sons (Pvt). Ltd.
6. Heat Transfer, by Vijay Gupta, New Age International (P) Ltd. Publishers
7. Heat Transfer, by Y.V.C. Rao, University Press.
8. Heat Transfer, by R. Yadav, Central Publishing House, Allahabad

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M.TECH (THERMAL ENGINEERING)
First Year
Semester – I

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
Thermal	Gas Dynamics and Flow Through Turbo machines	METH-1004	3L-1T-0P	4

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

CO1-Give examples of the main applications of turbo machines.

CO2-Determine the velocity triangles in turbo machinery stages operating at design and off design conditions.

CO3-Explain the working principle of various types of hydro turbines and know their application range.

CO4-Explain and understand how the flow varies downstream of a turbo machinery blade row.

UNIT:-1

Fundamental Equations of Steady Flow:-Continuity equation, Equations of Motion, Euler's equation, Bernoulli's equation, Energy equation, Stream Function and Velocity Potential.

UNIT:-2

Potential Flow:-Elementary potential flows, Uniform flow, Source, sink, vortex and doublet. Superposition of flow patterns. Flow over immersed bodies. Development of the aerofoil-lift and drag, Kutta-Joukowski Profile, pressure distribution over aerofoil blading.

UNIT:-3

Viscous Flow:-Incompressible Flow: Laminar turbulent flows: Navier Stoke's equation and exact solutions of steady flow problems. Flow through pipes, flow over flat plates. Laminar and turbulent boundary layers. Dimensional analysis.

UNIT:-5

Compressible Flow of Gases:-Isentropic and adiabatic flow, Stagnation and critical properties, Flow through ducts of constant area, Fanno line and Rayleigh line flows. Fundamental equations and variation in flow properties. Flow with normal shock waves governing equations, Prandtl Meyer and RankineHugoniot relations, Strength of a shock wave, Moving normal shock waves**.**

Cascade Tests:-Fundamental equation of flow through turbo machinery.Radial equilibrium equation.Vortex flow through turbo machines.Losses in turbo machinery.Dimensional analysis of flow through turbo machines. Surging and choking.

Text Book/References Books/ Websites:

1. Fundamentals of Compressible Flows – Yahya
2. Compressible Fluid Flow – Michel A. Saad
3. Introduction to Fluid Mechanics – Fox and Mc Donald
4. Turbo Machines – A. ValanArasu
5. Applied Fluid Dynamics Handbook – Robert D. Blevins

6. Int J. of Heat and Mass Transfer – Elsevier Pub
7. Fluid Dynamics Journal – Springer Pub.

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M.TECH (THERMAL ENGINEERING)
First Year
Semester – I

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
Thermal	Refrigeration & Air Conditioning	METH-1005	3L-1T-0P	4

Course Outcomes:- At the end of the course, the student will be able to,
CO1-Students should be able to understand various refrigeration cycles and evaluate performance using Mollier charts and/ or refrigerant property tables
CO2-Students should be able to illustrate the fundamental principles and applications of refrigeration and air conditioning system
CO3-Students should be able to obtain cooling capacity and coefficient of performance by conducting test on vapor compression refrigeration systems
CO4-Students should be able to present the properties, applications and environmental issues of different refrigerants

Unit-1

Refrigeration:-Introduction to refrigeration system, Methods of refrigeration, cornot refrigeration cycle, unit of refrigeration, Refrigeration effect & C.O.P.

Air Refrigeration cycles:-Open and closed air refrigeration cycles, Reserved cannot cycle, Bell Coleman or Reversed Joule air refrigeration cycle, Aircraft refrigeration system, Classification of aircraft refrigeration systems. Boot strap refrigeration, Regenerative, Reduced ambient, Dry air rated temperature (DART).

Unit-2

Vapour Compression System:-Single stages systems, Analysis of vapour compression cycle, use of T-S and P-H charts, Effect of change in suction and discharge pressure on COP effect of sub cooling of condensate & superheating of refrigerant vapour on COP of the cycle, actual vapour compression refrigeration cycle, Multistage vapour compression system requirement, Removal of flash gas, intercooling, Different configuration of multistage system, cascade system.

Unit-3

Vapour Absorption system:-Working principle of vapour absorption refrigeration system, comparison between absorption & compression systems, Elementary idea of refrigeration absorbent mixtures temperature concentration diagram & enthalpy concentration diagram adiabatic mixing of two streams, Ammonia-Water vapor absorption system, Lithium-Bromide water vapour absorption system, compression.

Refrigerants:-Classification of refrigerants, Nomenclature, Desirable properties of refrigerants, common refrigerants, Secondary refrigerants and CFS free refrigerants.

Unit-4

Air Conditioning:-Introduction to air conditioning, Psychometric properties and their definitions, Psychometric chart Different Psychometric processes, Thermal analysis of human body, Effective

temperature and comfort chart, cooling and heating load calculations, Selection of inside& outside conditions, Heat transfer through walls & roofs infiltration & ventilation Internal heat gain, Sensible heat factor (SHF), by pass factor Grand Sensible heat factor (GSHF) Apparatus dew point (ADP).

Unit-5

Refrigeration Equipment & Application:-Elementary knowledge of refrigeration & air conditioning equipment e.g compressors, condensers, condensers, evaporators &expansion devices Air washers, cooling, towers & humidifying efficiency, food preservation cold storage refrigeration freezers, Ice plant, water coolers, Elementary knowledge of transmission and distribution of air through ducts and fans, Basic difference between comfort and industrial air conditioning.

Text Book/References Books/ Websites:

1. Refrigeration and Air conditioning by Manohar Prasad, New Age International (P) Ltd. Pub.
2. Refrigeration and Air conditioning by CP Arora.
3. Refrigeration and Air conditioning byArora&Domkundwar.
4. Refrigeration and Air conditioning byStoecker& Jones.
5. Refrigeration and Air conditioning by Roy J. Dossat.
6. Refrigeration and Air conditioning by P.L. Baloney.
7. Thermal Environment Engineering by Kuhen, Ramsey &Thelked

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M.TECH (THERMAL ENGINEERING)
First Year
Semester – I

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
Thermal	THERMAL ENGINEERING LAB - I	METH-1006	0L-0T-2P	2

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

CO1: Measure the compressibility of real gases and dryness fraction of steam.

CO2: Evaluate the performance of variable compression engines, air conditioning systems, heat pipe and refrigeration system.

CO3: Analyze exhaust gases and test the evacuated tube concentrator.

CO4: Determine overall heat transfer co-efficient for double pipe heat exchanger with parallel and counter flow.

Course Content

This lab is to understand the basic principles in the areas of internal combustion engines, boilers and Refrigeration systems to under graduate and Post graduate students through a series of experiments. In this lab the experiments are performed to measure performance parameters of the systems such as Brake power, Efficiency, Torque, COP, mass of fuel. Students have a fairly good understanding of the theory underlying the experiments and the entire lab course is designed such that classroom lectures precede the lab work. The Thermal Engineering Laboratory is equipped with test facilities for doing research with in internal combustion engines for energy conversion.

Experiments in Thermal Engineering Lab - I

1. Study of I.C. Engines valve / port timing diagrams.
2. Study of I.C. Engines performance test (4 -stroke diesel engines)
3. Study of I.C. Engines performance test on 2-stroke petrol.
4. Study of I.C. Engines performance test on multi cylinders 4-stroke petrol engine
5. Study of Evaluation of engine friction by conducting Morse test on 4-stroke multi cylinder petrol engine.
6. Determination of FHP by retardation and motoring test on IC engine.
7. Study of I.C. Engines heat balance.
8. Performance test on variable compression ratio engines.
9. Performance test on reciprocating air compressor unit.
10. Study of Different types of boilers.

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M.TECH (THERMAL ENGINEERING)
First Year
Semester – I

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
Thermal	REFRIGERATION & AIR CONDITIONING LAB - II	METH-1007	0L-0T-2P	2

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

CO1-Understand the principles and applications of refrigeration systems.

CO2-Evaluate performance of Vapor compression refrigeration system.

CO3-Apply working principle of VAR/VCR system to solve numerical based on VCR and VAR system.

CO4-Understand basics of psychometric, air conditioning processes and different air conditioning systems.

Course Content

This lab is to understand the basic principles in the areas of Refrigeration & Air Conditioning and Refrigeration systems to under graduate and Post graduate students through a series of experiments. In this lab the experiments are performed to measure performance parameters of the systems such as Brake power, Efficiency, Torque, COP, mass of fuel. Students have a fairly good understanding of the theory underlying the experiments and the entire lab course is designed such that classroom lectures precede the lab work. The Refrigeration & Air Conditioning Laboratory is equipped with test facilities for doing research.

Experiments in R & A/c Lab II

1. Study of Simple Vapor compression Refrigeration System and its components.
2. Study of Cascade Refrigeration system for producing low temperature.
3. Study of Vapor Absorption refrigeration system.
4. Study of different psychometric terms and processes.
5. Study of different air-conditioning systems.
6. Study and Performance on Sling psychrometer.
7. Exhaust gas heat recovery type VAR system.
8. Study of measurement devices of all experimental setups used in RAC laboratory

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M.TECH (THERMAL ENGINEERING)
First Year
Semester – II

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
Thermal	INSTRUMENTATION AND CONTROL	METH-2001	3L-1T-0P	4

Course Outcomes: - At the end of the course, the student will be able to,
CO1-Develop advanced skills of technical communication in English.
CO2-Communicate confidently and competently in English language in all spheres.
CO3-Develop writing competence- technical report, business letters, job applications etc.
CO4-Develop reading comprehension skill through non-technical texts.
CO5-Conduct conversation practice: face to face and via media.

UNIT-1

Mechatronics :- Introduction of Mechatronics, Mechatronics key elements, Measurement systems, Control systems, Mechatronics approach problems, Mechatronics design process.

UNIT-2

Fundamentals of Measurement System:-Fundamental method of measurement, generalized measuring systems, stages in measurements, Sensor- transducer stage, signal conditioning stage, Terminating readout stage, types of input quantities – time dependant, analogue and digital signals. Measurement standards, calibration.

UNIT-3

Performance Characteristics of Instruments:-Introduction, static performance characteristics. Errors and Uncertainties, parameters. Dynamic performance characteristics: dynamic response, system transfer function and frequency response

UNIT-4

Elements of Measurement Systems:-Signal conditioning, Data presentation systems, Pneumatic and Hydraulic systems, Mechanical and electrical actuation systems, Basic system models, Microprocessors, Programmable logic controllers, communication systems.

UNIT-5

Applied Mechanical Measurements:-Determination of count, events per unit time and time intervals, Measurement of stress and strain, Pressure, Temperature, fluid flow, motion, Humidity, Torque and power measurements.

Text Book/References Books/ Websites:

1. “Instrumentation and Control Systems” by The CHAUVIN ARNOUX Group
2. “Instrumentation and Control Systems” by K N Reddy
3. “Instrumentation and Control Systems” by Bolton
4. Instrumentation and Control Systems” *Diksha P Gupta*
5. “Principles of Industrial Instrumentation and Control Systems” by Chennakesava R Alavala
6. “Instrumentation and Control Systems Documentation” by Fred A Meier and Clifford A Meier

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M.TECH (THERMAL ENGINEERING)
First Year
Semester – II

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
Thermal	THERMAL POWER PLANT ENGINEERING	METH-2002	3L-1T-0P	4

Course Outcomes: - At the end of the course, the student will be able to,
CO1: Describe the power generation scenario, the layout components of thermal power plant and analyze the improved Rankin cycle, Cogeneration cycle.
CO2: Analyze the steam condensers; recognize environmental impacts of thermal power plant and method to control the same.
CO3: Recognize the layout, component details of hydroelectric power plant and nuclear power plant.
CO4: Realize the details of diesel power plant, gas power plant and analyze gas turbine power cycle.

UNIT-1

Siting of Power Stations & Plant Layout:-The basic site requirements & selection, economics of fuel transport, transmission of electricity, government consolation. Effects of design parameters. Site layouts: Station layout, set arrangements, Boiler house arrangements, Turbine house arrangements, Plant control arrangements, Coal reception facilities.

UNIT-2

Power Plants Economics:-Effects of plant type on costs, rates, fixed elements, Energy Elements, Customer Elements, The investor's Profit Depreciation and replacement, Theory of rates. Load curve, Load duration curve, Load factor and diversity factor. Effect of load curve and diversity factor on the performance of power plant. Simple problems.

UNIT-3

Duct Work, Piping and Insulation:-Design and layout of ducting for air, fuel, gases and pulverized fuels. Selection of piping and pipe joints. Pipe flexibility analysis. Various valves, control valves motor operated valves, solenoid valves, selection of valves. Expansion of pipe lines, pipe joint, pipe supports, pipe layout, Pipe insulation, Optimum and Economic thickness, Specification of insulation.

UNIT-4

Power Plant Components:-Fuel and ash handling, pulverisers, pulverized fuel firing burbers, dust handling, concept of fluidized bed combustion. Radiant super heaters and reheaters, economizer and preheaters. Combustion and furnace design. Water supply and treatment system**.**

Draft and arrangement of draft fans, Type of Steam turbines, cylinder and rotor details, different types of cooling systems, open, closed, mixed and dry cooling tower system. Air cooled condensers. Ejector and vacuum pumps. Feed heating system. Low pressure and high pressure heaters, evaporators and desecrator, feed line protection. Boiler feed pumps, different type of drives, steam turbine driven boiler feed pump. Plant Instrumentation: General & Special Instrumentation, centralized & automatic control equipment, types of controls: Combustion, steam–temperature, feed water etc. Supercritical Power Stations: Plant components, principle of working, performance curves, flow diagram.

UNIT-5

Power Plant Testing:-Installation, adjustments & Commissioning, Preliminary performance checks, acceptance tests for various components, heat balance of individual items and of the entire plant commissioning of power plant.

Power Plant Management:-Preparing specifications, contract documents guarantees, buying equipment, power plant personal & their training, plant protection against fire and other hazards – selection and purchase of fuel. Seismic analysis for all power equipment to be installed in seismic zones.

Operation and Maintenance of Turbines:-Starting, loading and stopping of turbine, normal operation checks, maintenance logging, parallel operation, performance of the turbine as an individual unit and as a component of a power plant, Reliability, Availability and Maintainability of power plant.

Text Book/References Books/ Websites:

1. Power Plant Engineering – Arora & Domkundwar
2. Power Plant Engg.–P.K. Nag
3. Modern Power Station Practice – 10 Volumes in Reference British Electricity Int. Ltd
4. Power Technology and Engineering Journal – Springer Pub. New York

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M.TECH (THERMAL ENGINEERING)
First Year
Semester – II

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
Thermal	Theory & Design of Heat Exchangers	METH-2003	3L-1T-0P	4

Course Outcomes:-At the end of the course, the student will be able to
CO1-Students will be able to learn and explain various modes of heat and mass transfer operations in food processing industry.
CO2-Understand the basic laws of heat transfer.
CO3-Analyze heat exchanger performance by using the method of log mean temperature difference.
CO4-Evaluate heat transfer coefficients for natural convection. 8. Evaluate heat transfer coefficients for forced convection inside ducts.

UNIT-1

Introduction:-Classification, temperature distribution for parallel flow, counter flow, cross flow, heat exchanger, evaporators and condensers concept of LMTD and overall heat transfer coefficient.

UNIT-2

Types of Heat Exchangers:-Fouling of heat exchangers, NTU method for gauging exchanger performance, LMTD for parallel, counter and cross flow heat exchangers, effectiveness for parallel and counter flow exchangers.

UNIT-3

Important design consideration: Material selection and optimization of heat exchangers, analysis of regenerative heat exchangers.

UNIT-4

Vibration in Heat Exchangers:-Vibration induced by flow, International

standards for heat exchangers.

UNIT-5

Thermal and mechanical design of Heat Exchangers:-

a. Shell & tube heat exchangers
b. Double pipe
c. Extended surface
d. Condensers & evaporators
e. Boilers & feed water heaters
f. Air preheaters
g. Dictators
h. Heat exchanger for nuclear application

Text Book/References Books/ Websites:

1. Design of Heat Exchanger – Kern
2. Principles of Heat Transfer – Kreith Bohn
3. Heat Exchanger Design, Handbook – Begell House Inc.
4. Journal of Heat Transfer – ASME Pub

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M.TECH (THERMAL ENGINEERING)
First Year
Semester – II

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
Thermal	Design of Power Generation System	METH-2004	3L-1T-0P	4

Course Outcomes:-At the end of the course, the student will be able to
1. Ability to understand the Layout of Various Generating Power Stations.
2. Ability to Design Turbine Layout of Various Generating Stations.
3. Ability to Determine design parameters required for Distribution systems.
4. Ability to understand the features and need of various Compensation Systems.

UNIT-1

Stator Design:- Design of casing & Diaphragms: Design and construction of diaphragms, diaphragms considering flow analysis casing stream sealing systems, labyrinth, glands, packing & bearing, design and RAM analysis of steam turbine components.

UNIT-2

Rotor Stresses & Design:- Design of turbine rotors. Rotors of constant strength and of constant thickness rotors with hyperbolic profile. Temperatures stresses in rotors, graphical method of modification of rotor profile, mathematical and finite difference methods of calculating stresses in rotors of given profile. Wheel drums stress analysis of drums, type of rotors, stresses at slots.

UNIT-3

Turbine Rotor Vibration:- Critical speeds balancing of rotors, Stress analysis of steam turbine diaphragm components. Diaphragms of constant and variable thickness. Blade section, centrifugal stresses in blades, gas bending stresses, blade vibrations analysis of factors causing blade vibrations. Experimental techniques for the study of blade vibrations. Numerical analog and other experimental methods for studying blades stresses.

UNIT-4

Steam Turbine Systems:- Design procedure for steam turbine stages. Blade erosion, Binary vapour cycle and cogeneration. System of turbine governing. Over speed tripping design of the lubrication system.

UNIT-5

Engines Systems:- (a) Fuel exchange: S.I. Engine, C.I. Engines and Gas Turbines (b) Combustion: S.I. and C.I. Engine Combustion, Gas Turbines & Combustion chamber design.
Trends in Engine Technology:

a. Gas Exchange process: Valve operation & manifolds valves configuration, variable valve actuation, valve failure and maintenance. Induction process & exhaust process & systems.
b. Alternative Technology- Alternative power sources: Fuel cells, Hybrid engine technology, rotary engines etc. Fuel: Use for alternative fuels.

Text Book/References Books/ Websites:

1. Steam Turbine – R. Yadav
2. Steam Turbines – Keorton
3. IC Engines Fundamentals – J.B. Heywood
4. Introduction to IC Engines – Richard Stone

5. Power Generation Handbook – Philip Kiaheh
6. Internal Combustion Engine Handbook – Richard Van Basshuyeen, Fred Schacfer
7. Journal of Engineering for Gas Turbine and Power – ASME Pub.

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M.TECH (THERMAL ENGINEERING)
First Year
Semester – II

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
Thermal	WIND ENERGY AND ITS UTILIZATION	**METH-2005**	**3L-1T-0P**	**4**

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

CO1-Understand the need of energy conversion and the various methods of energy Storage.

CO2- Identify Winds energy as alternate form of energy and to know how it can be tapped.

CO3. Understand the Geothermal &Tidal energy, its mechanism of production and its applications.

CO4- Illustrate the concepts of Direct Energy Conversion systems & their applications.

UNIT-1

Economics decommissioning present status and future trends. Characteristics of wind: Nature of atmosphere winds resources characteristics and assessment anemometry wind statistics speed frequency distribution effect of height wind rose we bull distribution atmosphere turbulence gust wind speed effect of topography.

UNIT-2

Aerodynamics of blade and rotor:- Aerodynamics of aerofoil lift stall effect of Reynolds's number actuator disc momentum theory and bet z coefficient design of wind turbine blade stall regulation coefficient of power optimal choice of cut in rated and cut out wind speeds blade materials.

UNIT-3

Wind turbine design:- Vertical and horizontal axis turbine design characteristics multiple stream tube theory vortex wake structure tip losses rotational sampling wind turbine design programs aerodynamics loads tower shadow wind shear blade coning gyroscopic transient and extreme loads aerodynamic damping and stability teetering motion stiff and soft towers power train dynamics.

UNIT-4

Electrical elements control and mechanism:- Pitch control yaw control aerodynamic braking teeter mechanism control policies and their effect on energy capture and mechanical stress on wind turbine components. Wind turbine dynamics with induction and synchronous generators power electronics interfaces for variable speed operation wind farm electrical design effect of wind turbulence and wind farm geometry on system voltage flicker.

UNIT-5

Wind farm:- Planning of wind farms special application for developing countries maintenance and operation wind farm management site selection and optimum siting environmental issues noise visual impact etc.

Text Book/References Books/ Websites:

1. Wind energy conversion system=L.L. Freris, Printice hall
2. Wind Turbine Engineering design – Eglantine & Stoddard
3. Wind energy comes of age- Paul Gipe Johan Wiley & Sons Inc
4. Wind Energy Hand book- Tony Burton et al, Johan Wiley & Sons Inc
5. Int. J. Wind Energy
6. Journal of Wind Engineering and industrial aerodynamics- Elsevier Pub.

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M.TECH (THERMAL ENGINEERING)
First Year
Semester – II

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
Thermal	THERMAL ENGINEERING LAB - II	METH-2006	0L-0T-2P	2

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

CO1. Recognize typical designs of turbo machines and differentiate from positive displacement machines.

CO2. Explain the working principles of turbo machines and apply it to various types of machines.

CO3. Recognize relations between choices made early in the turbo machinery design process and the final components and operability.

CO4. Recognize and discuss today's and tomorrow's use of turbo machines for enabling a sustainable society.

COURSE CONTENTS

This lab is to understand the basic principles in the areas of Thermal Engineering and turbo machines systems to under graduate and Post graduate students through a series of experiments. In this lab the experiments are performed to measure performance parameters of the systems such as wind tunnel, Efficiency, Gas Turbine, Pitot tube, mass of fluid. Students have a fairly good understanding of the theory underlying the experiments and the entire lab course is designed such that classroom lectures precede the lab work. The Heat Balance sheet for C.I. Engine Laboratory is equipped with test facilities for doing research.

EXPERIMENTS LIST OFTHERMAL ENGINEERING LAB - II

1. Study to wind tunnel.
2. To determine volume flow rate for low speed wind tunnel using pitot tube.
3. To study flow around circular/Irregular shaped Body.
4. Calibration of Thermocouple.
5. Heat Balance sheet for C.I. Engine.
6. To find effect of compression Ratio of I.C. Engine performance.
7. Study of Experimental facility on 4 BHP and 40 BHP steam turbine available in laboratory.
8. Study of Gas Turbine.
9. To conduct Numerical experiments with IDEAS and FLUENT software for exploration of problems related to fluid flow and Heat transfer including learning of using these software experiments on Instrumentation.

R K.D.F. UNIVERSITY, BHOPAL
M.TECH (THERMAL ENGINEERING)
Second Year
Semester – III

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
Thermal	(ELECTIVE-I) THEORY AND DESIGN OF BLOWERS AND COMPRESSORS AND INDUSTRIAL STEAM TURBINES	METH-3001	3L-1T-0P	4

Course Outcomes:-At the end of the course, the student will be able to,
CO1- To have a concept of discrete probability density functions and probability distributions like Binomial Distribution and Poisson distribution.
CO2- To have a concept of continuous probability density functions and probability distributions like Normal, Gamma and Exponential distribution.
CO3- To understand the concept of Laplace and inverse Laplace transforms and apply them to solve ordinary differential equations.
CO4- To use the iteration and interpolation methods to solve engineering problems.

UNIT-1

Introduction:-Energy interchanges in fluid machinery, momentum-principle streamline theory, momentum and circulation.

UNIT-2

Compressor/ Turbine/Blower:-Theory of centrifugal impeller for incompressible fluid, velocity triangle-impeller for approach and peroration vortex theory. Blower casing volute, vaned and vane less diffuser, thermodynamics of turbo blowers, Dimensionless characteristic of turbo blowers.

UNIT-3

Axial Flow compressors:- Two dimensional cascade. Theoretical analysis of performance and experimental works. Howell's and Cartter's correlations for low speed, Effect of Reynolds and mach numbers. Pitch line design of axial flow compressor.

UNIT-4

Radial equilibrium:- calculation of losses and stage efficiencies in the diseases blades-interstate traversing, measurements of total and static pressure and vane angles.

UNIT-5

Types of flow:-Transonic and supersonic compressors. Industrial steam Turbines. Type of Steam Turbines.

Text Book/References Books/ Websites:

1. Turbines Fans and compressors - S.M. Yahya
2. A practical Guide of Steam Turbine Technology – Heinz P. Bloch
3. Compressor Handbook – Paul Hanlon
4. Journal of Turbo machinery – ASME Pub

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Second Year
Semester – III

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
Thermal	(ELECTIVE-I) ADVANCE VIBRATION SYSTEM	METH-3001	3L-1T-0P	4

Course Outcomes:-At the end of the course, the student will be able to,
CO1-Understand free and forced vibrations of single degree freedom systems Turbo Machinery.
CO-1-Explain Inertia force and inertia torque in reciprocating engine & Equivalent dynamical system of .
CO-2-Analyze balancing problems in rotating and reciprocating machinery.
CO-3-Characterize and design flywheels.
CO-4-Analyze and design centrifugal governors.

UNIT-1

Introduction:-Vibration and Its Application For Design of Turbo Machinery Importance of Vibration Study in engineering, Elements of a vibrating system, Free vibration of single degree of freedom linear systems Methods of vibration analysis: Energy method. Newton's method & Rayleigh method. Deferential equation of motion for first order and. Second order linear systems. Transverse vibration of beams. Damped free vibration, viscous, coulomb damping dry friction logarithmic decrement.

UNIT-2

Forced vibration:- of single degree of freedom linear systems. Response of first order systems to harmonic excitation. Frequency response. Response of second order systems to harmonic excitation. Rotating unbalance, whirling of rotating shafts.

UNIT-3

Types of vibration:-Harmonic motion of the base, vibration isolation, transmissibility, force transmission to foundations. Vibration measuring instruments eg. Seismic mass micrometer, Accelerometer. Energy dissipation. Forced vibration with coulomb hysteresis of structural & viscous damping.

UNIT-4

Two degrees of freedom system :-Equation of motion for a two degrees of freedom system. Free vibration of un damped systems. Natural modes. Orthogonality of modes. Natural co-ordinates. Response of a two degrees of freedom system to initial and harmonic excitation. Dynamic absorbers Lagrange's equation influence coefficients, semi definite system.

UNIT-5

Torsional vibration:- one, two and three rotor system. Equivalent shafting. Torsional vibration of a geared system. Torsion vibration with harmonic excitation, Critical speed of a shaft having a single disc with damping.

Text Book/References Books/ Websites:

1.Mechanical Vibrations – G. K. Grover
2.Theory of Vibration with Application – Thomson
3.Mechanical Vibration – Den Hartog
4.Mechanical Vibration – Steidel
5.Shock and Vibration Handbook Vol I, II, II – Harris and Creed
6.Journal of Sound and Vibration –Elsevier Publication

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M.TECH (THERMAL ENGINEERING)
Second Year
Semester – III

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
Thermal	(ELECIVE-II)GENERAL COMPUTER AIDED DESIGN	METH-3002	3L-1T-0P	4

Course Outcomes:-At the end of the course, the student will be able to,
CO1- Understand the concepts of CAD and CAD tools.
CO2- Design and create Part Models and Assembly Models
CO3- Understand concepts 3D Modelling: Concepts, Wireframe, Surface, and Solid Modeling
CO4- Create Engineering Drawings by using Part and Assembly models

COURSE CONTENT

GENERAL COMPUTER AIDED DESIGN

Computer Technology Data Representation languages Operating The Computer System introduction to workstations graphic terminals Input/output devices graphic package fundamental of CAD design process. Database constructing the geometry wire frame and solid model auto cad software package and its applications. Use of out slip CAD CAM integration introduction to software packages and its applications.

Text Book/References Books/ Websites:

1. Engineering Design G.E. Dieter. Mc. Graw Hill Pub
2. CAD/CAM Ibrahim Zied. McGraw Hill Pub
3. CAD/CAM Grover & Zimmer, P.H.I. Pub

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M.TECH (THERMAL ENGINEERING)
Second Year
Semester – III

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
Thermal	(ELECTIVE – II) CONCURRENT ENGINEERING	METH-3002	3L-1T-0P	4

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

CO1- The graduates shall have the ability to understand the importance of product design in leveraging both manufacturing cost and product lifecycle cost.
CO2- The graduates shall have the ability to plan and implement a product development program.
CO3-The graduates shall have the ability to participate in multi-discipline Integrated Product Development teams.
CO4-The graduates shall have the ability to design and conduct experiments to ensure that the product design is robust and compatible with the capability of the manufacturing process.

Introduction to concurrent Engineering:- Fundamentals of CE. Need and basic principles of CE benefits of implementation of CE Introduction to various integrating mechanisms forming of CE team teamwork: Interfacing of manufacturing and design selection of the techniques and methodologies selection of CE tools.

Quality by design quality function deployment methodology:- Taguchi methods of rebust design, Design for manufacturability: virtual manufacturing.

Introduction to value engineering:- value Engineering analysis and techniques design for assembly introduction to various DFA technologies.

Rapid prototyping :-Need and use of RP, Various RP technologies, Design for reliability fundamentals and design for reliability principles design for serviceability factors affecting serviceability evaluation design for maintainability and Economics.

2. Text Book/References Books/ Websites:

1. John R.Hartley, Susmu Okamato “Concurrent Engineering shortening leed times raising quality & lowering costs.”
2. Don classing. “Total quality development, a step by stop guide to world class concurrent engineering.
3. Thomos A Salomone. “Concurrent engineering what every engineer should know about series.”

M.TECH (THERMAL ENGINEERING)

Second Year

Semester – III

Course Content & Grade

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
THERMAL ENGINEERING	**Seminar**	**METH-3003**	**0L-0T-2P**	**2**

Course Outcomes: After studying this course, students will be able to,

CO1-Recognize and examine ethical situations that affect engineering.

CO2-Identify and anticipate professional issues as a Production & Industrial engineer.

CO3-Prepare for management of ethical and legal issues that Production & Industrial engineers face as Professionals. CO4-Understand the need to be knowledgeable of contemporary issues.

Course Content

In this Seminar the students will learn Objective of Group Discussion and it is to improve the mass communication Skill, It is to give student an opportunity to exercise their rights to express them & to enhance understanding skills of students, to improve convincing power of students.

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M.TECH (THERMAL ENGINEERING)
Second Year
Semester – III
Course Content & Grade

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
THERMAL ENGINEERING	**Dissertation Part- I (Literature Review/Problem Formulation/ Synopsis**	**METH-3004**	**0L-0T-2P**	**2**

Course Outcomes: After studying this course, students will be able to,

CO1- To define and limit of the research.

CO2- To place your study in an historical perspective.

CO3- To avoid unnecessary duplication.

CO4- To evaluate promising research methods.

Course Content

The objective of Dissertation Part-I is to promote a systematic understanding of the knowledge, critical awareness of current problems, originality in the application of knowledge and the quality of work. The ideal work may be characterized by a new result in design, development and implementation. It should have the potential of industrial/scientific acceptance. The first part of the Dissertation should be to determine the interest of students and broadly identify the area of work, finalize the research problem based on literature survey. Also, by now the students should have familiarity with the concepts, tools, techniques required to carry out the Dissertation work. Student is expected to start the research work. Outcome of Dissertation Part-I should be to conclude the work on the identified problem its importance, its justification, literature survey, field work, research work etc. Minor variation may be accepted depending upon nature of title.

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M.TECH (THERMAL ENGINEERING)
Second Year
Semester – IV

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credit
Thermal Engineering	DISSERTATION – II	**METH-4001**	**0L-0T-2P**	**2**

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

CO1- The programme of instruction will consist of advanced subjects of the respective specialization. The complete programme is distributed over four semesters with two semesters per academic year. Course work is offered in the first two semesters (except for PG programme in Computer Science where it is extended up to third semester) and the dissertation work will be carried out during third and fourth semesters. Every branch of M.E/M.Tech programme will have a curriculum and syllabi for the courses recommended by the board of studies and approved by the academic council. The academic programmes of the Institute follow the credit system.

CO2- Every candidate shall be required to submit the record of dissertation work at the end of fourth semester.

Course Content

The objective of Dissertation Part-I is to promote a systematic understanding of the knowledge, critical awareness of current problems, originality in the application of knowledge and the quality of work. The ideal work may be characterized by a new result in design, development and implementation. It should have the potential of industrial/scientific acceptance. Dissertation Part-II should be seen in continuation with Dissertation Part-I. The researcher should continue the research work in the two parts.