COURSE SCHEME
EXAMINATION SCHEME
ABSORPTION SCHEME
&
SYLLABUS

Of

First, Second, Third & Fourth Semester
Choice Base Credit System (CBCS)

Of

Master of Technology (M.Tech)

In

HEAT POWER ENGINEERING (HPE)

Of

RASHTRASANT TUKDOJI MAHARAJ
NAGPUR UNIVERSITY, NAGPUR

Rashtrasant Tukadoji Maharaj Nagpur University Nagpur
Faculty of Engineering & Technology
Course and Examination Scheme of Master of Technology
Choice Base Credit System (CBCS)

I Semester M. Tech. (Heat Power Engineering)

Subject Code	Subject	Teaching Scheme			Examination Scheme								
					Theory					Practical			
		Hours per week		No. of Credits	Duration of Paper (Hrs.)	Max. Marks	Max. Marks	Total Marks	Min. Passing Marks	Max. Marks	Max. Marks	Total Marks	Min. Passing Marks
		L	P			UA	CA			UA	CA		
PGHPE101T	Advanced Heat & Mass Transfer	4	-	4	3	70	30	100	50	-	-	-	-
PGHPE102T	Advanced Thermodynamics & Combustion Technology	4	-	4	3	70	30	100	50	-	-	-	-
PGHPE103T	Internal Combustion Engines	4	-	4	3	70	30	100	50	-	-	-	-
PGHPE104T	Elective –I (Discipline)	4	-	4	3	70	30	100	50	-	-	-	-
PGOPEN105T	Elective –II(Open)	4	-	4	3	70	30	100	50	-	-	-	-
PGHPE106P	Advanced Heat & Mass Transfer (*Laboratory -I)*	-	2	1	-	-	-	-	-	50	50	100	50
PGHPE107P	Internal Combustion Engines (*Laboratory -II)*	-	2	1	-	-	-	-	-	50	50	100	50
Total		20	4		-	350	150	500	-	100	100	200	-
Semester Total		24		22	700 Marks								

Elective I - (Discipline)

1. Advanced Energy Technologies
2. Power Plant Practice and Control
3. Computer Aided Design & its application in thermal systems.

Elective II - (open)

1. Energy Conservation and Management
2. Automobile Engineering
3. Advanced Operation Research

Rashtrasant Tukadoji Maharaj Nagpur University Nagpur
Faculty of Engineering & Technology
Course and Examination Scheme of Master of Technology
Choice Base Credit System (CBCS)

II Semester M. Tech. (Heat Power Engineering)

Subject Code	Subject	Teaching Scheme			Examination Scheme								
					Theory					Practical			
		Hours Per week		No. of Credits	Duration of Paper (Hrs.)	Max. Marks	Max. Marks	Total Marks	Min. Passing Marks	Max. Marks	Max. Marks	Total Marks	Min. Passing Marks
		L	P			UA	CA			UA	CA		
PGHPE201T	Refrigeration & Air Conditioning Technologies	4	-	4	3	70	30	100	50	-	-	-	-
PGHPE202T	Thermal Engineering	4	-	4	3	70	30	100	50	-	-	-	-
PGHPE203T	Advanced Fluid Mechanics	4	-	4	3	70	30	100	50	-	-	-	-
PGHPE204T	Elective –III (Discipline)	4	-	4	3	70	30	100	50	-	-	-	-
PGHPE205T	Foundation Courses -I	4	-	4	3	70	30	100	50	-	-	-	-
PGHPE206P	Refrigeration & Air Conditioning Technologies *(Laboratory -III)*	-	2	1	-	-	-	-	-	50	50	100	50
PGHPE207P	Thermal Engineering *(Laboratory -IV)*	-	2	1	-	-	-	-	-	50	50	100	50
Total		20	4		-	350	150	500	-	100	100	200	-
Semester Total		24		22	700 Marks								

Elective III - (Discipline)

1. Heat Exchange Analysis and Design
2. Computational Fluid Dynamics
3. Thermal Storage System

Foundation Course I: Research Methodology

Rashtrasant Tukadoji Maharaj Nagpur University Nagpur
Faculty of Engineering & Technology
Course and Examination Scheme of Master of Technology
Choice Base Credit System (CBCS)

III Semester M. Tech. (Heat Power Engineering)

Subject Code	Subject	Teaching Scheme			Examination Scheme								
					Theory					Practical			
		Hours Per week		No. of Credits	Duration of Paper (Hrs.)	Max. Marks	Max. Marks	Total Marks	Min. Passing Marks	Max. Marks	Max. Marks	Total Marks	Min. Passing Marks
		L	P			UA	CA			UA	CA		
PGOPEN301T	Elective –IV (Open)	4	-	4	3	70	30	100	50	-	-	-	-
PGHPE302T	Foundation Courses -II	4	-	4	3	70	30	100	50	-	-	-	-
PGHPE303P	Project Seminar	-	-	8	-	-	-	-	-	-	200	200	100
Total		8	-		-	140	60	200	-	-	200	200	-
Semester Total		-		16	400 Marks								

Note : For the teaching work load calculation for Project Seminar, work load will be 3 hours per week per project

Elective –IV (Open)

1. Mechatronics
2. Environmental Pollution and Control
3. Optimization Methods in Engineering

Foundation Course II

Project Planning and Management

Rashtrasant Tukadoji Maharaj Nagpur University Nagpur
Faculty of Engineering & Technology
Course and Examination Scheme of Master of Technology
Choice Base Credit System (CBCS)

IV Semester M. Tech. (Heat Power Engineering)

Subject Code	Subject	Teaching Scheme			Examination Scheme								
					Theory					Practical			
		Hours Per week		No. of Credits	Duration of Paper (Hrs.)	Max. Marks	Max. Marks	Total Marks	Min. Passing Marks	Max. Marks	Max. Marks	Total Marks	Min. Passing Marks
		L	P			UA	CA			UA	CA		
PGHPE401P	Project	-	-	16	-	-	-	-	-	400	-	400	200
Total		-	-		-	-	-	-	-	400	-	400	-
Semester Total		-		16	400 Marks								

Note : For the teaching work load calculation for project, work load will be 6 hours per week per project

ABSORPTION SCHEME FOR M.TECH. [HEAT POWER ENGG.] CBCS PATTERN

Name of the subject in old syllabus	**Equivalent subject in CBCS from 2016-17**
Heat transfer –I (Sem-I)	Advanced Heat and mass transfer (Sem-I)
Advanced Thermodynamics (Sem-I)	Advanced Thermodynamics and combustion (Sem-I)
Thermal Engg. –I (Sem-I)	Thermal Engineering(Sem-II)
Advanced Energy Technology(Sem-I)	Advanced Energy Technology(Sem-I)- Elective –I
Computer Aided Design(Sem-I)	Computer Aided Design & its application in thermal systems. (Sem-I)- Elective –I
Fluid Dynamics(Sem-II)	Advanced Fluid Mechanics (Sem-II)
Heat Transfer-II(Sem-II)	Advanced Heat and mass transfer (Sem-I)
Refrigeration and Air conditioning (Sem-II)	Refrigeration & Air Conditioning Technologies(Sem-II)
Thermal Engg. –II(Sem-II)	Thermal Engineering(Sem-II)
Energy conservation and Management(Sem-II)	Energy conservation and Management(Sem-I)- Open Elective-I
Thermal Storage system(Sem-III)	Thermal Storage system (Sem-II) Elective-III
Design of I.C. engines and subsystems(Sem-III)	I.C. engines (Sem-I)

PGHPE101T ADVANCED HEAT AND MASS TRANSFER

Outcomes-: It gives broad exposure to the students to understand fundamental laws of heat transfer and its application It familiarize the students with numerical manipulation and order of magnitude of various parameter in the heat transfer subject. student come out with to apply the basic principle of heat transfer to new situation and develop their own equation to get the solutions

UNIT I

Conduction Extended surfaces-steady state analysis and optimization –radial fins of rectangular and hyperbolic profiles-longitudinal fin if rectangular profile radiating to free space
Transient heat conduction-Exact solution-Use of Heisler and Grober chart-integrated method
Multi dimensional heat conduction: Analytical, Graphical and Numerical methods of analysis, Conduction shape factor,

UNIT II

Convection: Thermal boundary layers - Momentum and energy equations, integral equation - Internal and external flows. Forced convection over cylinders, spheres and bank of tubes.
Free convection: Laminar and Turbulent flows, analytical and empirical solutions, Numerical Problems. Boiling and condensation

UNIT III

Radiation –Radiative exchange in furnaces, radiation characteristics of particle system, thermal radiation of a luminous fuel oil and gas-soot flame-overall heat transfer in furnaces

UNIT IV

Mass Transfer: Definition, Examples, Fick's law of diffusion, Fick's law as referred to ideal gases, Steady-state Isothermal Equi-molal counter diffusion of ideal gases, Mass diffusivity, Gilliland's equation, Isothermal evaporation of water and its subsequent diffusion into dry air, Mass transfer coefficient

References

1. Ozisik, M.N., *Heat Transfer - A Basic Approach,* McGraw-Hill, 1987.
2. J.P. Holman, "Heat Transfer", McGraw Hill Book Company, New York, 1990
3. Kays, W. M. and Crawford, M. E., Convective Heat and Mass Transfer, Tata McGraw Hill, 4th Edition, 2012.
4. Heat Transfer: A practical approach,Y.A.Cengel, 2nd edition, McGraw Hill , 2003

PGHPE102T : ADVANCED THERMODYNAMICS AND COMBUSTION TECHNOLOGY

Course Outcomes :-

- Apply the law of thermodynamics to closed and open systems including thermodynamics cycle
- Determine properties of real gases
- Estimate physical properties of mixtures, especially non-ideal mixtures
- Analysis the gas power cycle and steam power cycle
- Understanding basics of combustion phenomena.

UNIT-I :

Review of basic thermodynamics principle, Analysis of Engineering process in Thermodynamics – Control mass analysis, control volume analysis, first law of thermodynamics for a control volume. Transient flow processes, charging of a cylinder, discharging of a cylinder, Second law analysis of Engineering Processes, Second law analysis of control volume, entropy, availability and irreversibility

UNIT-II :

Thermodynamic relations – Vander waals equation of state, Virial equation of state, compressibility charts, Maxwell's relations, Mineomonic Disgrams,

UNIT-III :

Gas and Gas – Vapour Mixtures of gas, Mixing of ideal gases, mixtures of real gases and vapours, process of mixtures of ideal gases and vapours. Thermodynamic potentials, Helmholtz potential, Clapeyron equation,

UNIT-IV :

Introduction of combustion theories , Stoichiometry, Chemistry of combustion reactions, Excess air. First and Second law of thermodynamics applied to combustion, combustion mass balance, combustion energy balance.

UNIT-V

Fundamentals of combustion Kinetics, Laminar Flame Propagation, Flammability, limits and quenching of laminar flames, Turbulent flame propagation, Flame stabilization.

Reference Books:

1. Engineering Thermodynamics by P. K. Nag, Tata Mc-Graw Hill Publication
2. Thermodynamics by Van Wyen and Sonntag
3. Thermodynamics –An Engineering by Yunis A. Cengel, Micheal Boles
4. Fundamentals of Engineering Thermodynamics – John R. Nowell, Richard O. Buckiur.
5. Fundamental of Combustion by D.P. Mishra
6. Introduction to combustion phenomena, by A. Murthy Kanury, Gordon and Breach

PGHPE103T INTERNAL COMBUSTION ENIGINES

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

1. *Apply thermodynamic analysis to IC engines and describe combustion phenomena in spark ignition and compression ignition engines.*
2. *Describe the working of major systems used in conventional and modern engines.*
3. *Summarize the methods used to improve engine performance and estimate performance parameters.*
4. *Describe engine emission control techniques and implement viable alternate fuels.*

UNIT - I

Classification of engines, Ideal model of engine cycles-thermodynamic analysis of Otto, Diesel and Dual cycles, air-fuel cycle analysis, actual cycle analysis, Thermo chemistry of fuel air mixture, properties of working fluids, Engine performance parameters and their significance, Alternative fuels.

UNIT - II

Combustion in SI and CI engines (normal and abnormal), Combustion chambers for SI and CI engines, Carburetion,Fuel injection system- SI engine fuel injection (MPFI and GDI), CI engine fuel injection system, size of fuel droplets, spray patterns, Electronic engine management.

UNIT - III

Performance of engines- measurement of power (bp, ip and fp), calculation of efficiencies and specific fuel consumption, Factors affecting performance- Heat loss, Air-fuel ratio, Pumping loss, Energy balance sheet, Pi and Sankey diagrams.

UNIT - IV

Pollutant emissions from IC engines:Introduction to clean air, Pollutants from IC engines- Carbon monoxide, UBHCs, Oxides of Nitrogen and particulate matter, Mechanism of formation of emissions-CO,HCs and NOx, Measuring instruments, Pollution control strategies, Emission norms- EURO and Bharat stage.

Supercharging of engines- Methods of increasing performance of engines, need of supercharging, Configuration of supercharges and engine modification to incorporate supercharger.

References

1. Heywood J. B., *Internal Combustion Engine Fundamentals*, McGraw Hill Co.
2. Obert E. F., *I C Engines and Air Pollution* Haper and Row publications.
3. Ganeshan V., I*nternal Combustion Engines*, Tata McGraw Hill Co.
4. Gupta H.N., *Fundamentals of Internal Combustion Engines*, Prentice Hall of India.
5. Mathur M.L.& Sharma R.P., *Internal Combustion Engine*, Dhanpat Rai Publications.

PGHPE104T

ELECTIVE – I ADVANCED ENERGY TECHNOLOGIES

Course Outcomes: This course is design to make the student conversant with non-conventional energy sources and their utilization to harness power. The students will be learning solar energy utilization and its applications. The generation of power with use of wind energy. Also students can understand power generation thorough geothermal energy, ocean energy; magneto hydrodynamic power generation, fuel cell, biomass and also nuclear energy.

UNIT - I

Solar Energy : Structure of sun, energy radiated by sun. Angular relationship of earth and sun position, solar radiation & its measurement, calculation of incident angle global radiations, solar day length, derivations and numericals.Flat plate collectors; types and constructional details of flat plate collection. Heat transfer through fluid and performance analysis of flat plate collector. Concentrating collections its design and analysis. Solar energy storage system and design.

UNIT - II

Applications of solar energy, solar pond, solar thermal power plant. Photo voltaic power, solar cell, commercial solar cells, economics of photo voltaic, environmental impact of photo voltaic, fuel cells efficiency & its types, thermoelectric generator.

Wind Energy: Sources of wind energy, wind velocities, power in wind, various types of wind mills and their constructional details and performance study, modern wind turbines, power output of wind turbine applications for pumping and power generator.

UNIT - III

Ocean Energy : Tidal power, single basin and double basin arrangements, power generated through tides, ocean thermal energy conversion systems.

Geothermal Energy : Geothermal energy resources, power generation methods such as vapour dominated system, liquid dominated system,

Magneto Hydro Dynamic Power Generation: Principle of MHD power generations, open & closed cycle system power output from MHD generator.

UNIT - IV

Biomass Energy : Gasifiers, direct thermal application of gasifier. Advantages and problems in development of Gasifiers.

Nuclear Energy : Nuclear fusion and Fission, Fission reactive type, Reactor control. Pressured water reactor, Boiling water reactor, gas cooled reactor, pressurized heavy water reactor.

References

6. Solar Energy Principles of Thermal collection and storage by Sukatme- Tata Mcgraw Hill.
7. Solar Energy Thermal Processes' by Duffe & Beckmen - John Willey & sons.
8. Principles of Solar Engineering - Krieth and J.F. Krieeder- Tata Mcgraw Hill.
9. Energy Science-Principles, Technologies and Impact John Andraw and Nick Jelley, Oxford University Press.
10. Introduction to Nuclear Technology, John R, Lamarsh, Anthony J. Baratta, Pretice Hall, 3rd edition.
11. Renewable Energy Resources-John Twiedell and Tony Weir –Taylor and Francis
12. Solar Fundamental and applications,-Gard H.P. And Praksh J., Tata Mcgraw Hill publications.

PGHPE104T Elective–I POWER PLANT PRACTICE AND CONTROL

UNIT I

Introduction: Energy reserves and Energy utilization in the world, Electrical power Generation & consumption in India. Types of power plants, merits and demerits, Criteria for selection of power plant. Power Plant Economics.

Hydro Electric Power Plants: Rainfall and run-off measurements and plotting of various curves for estimating stream flow and size of reservoir, power plants design, construction and operation of different components of hydro-electric power plants, site selection, comparison with other types of power plants.

UNIT II

Steam Power Plant: Layout, Super Heaters, Reheaters, Condensers, Economizers and Feed Water heaters, Operation and performance, Rankine cycle with Superheat, Reheat and Regeneration. Super critical boilers,Fluidized Bed combustion boiler - Advantages, Waste heat Recovery boilers, Co-generation Power Plant, Emissions and their controls.

UNIT III

Nuclear Power Plant: Overview of Nuclear Power Plant, Nuclear physics Radio activity-fission process Reaction Rates, diffusion theory and Critical heat flux -Nuclear Power Reactors, different types, advantages and limitations, Materials used for Reactors. Hazards in nuclear power plant, remedial measures, safety precautions, methods of waste disposal, different form of waste from power plant.

UNIT IV

Gas Turbine : Layout of Gas Turbine, Basic Gas turbine cycle, cycle improvements, Intercoolers, Reheaters and regenerators, Thermodynamic analysis of Gas turbine, Operations and performance of Gas Turbine. Combined Cycle Power Plant: Binary vapour cycles, Coupled cycles, Combined Power cycle Plants, Advantages and Limitations, Gas turbine,Steam turbine Power Plant and MHD, Steam Power Plant. Water pollution and Solid waste management in power plants, Effluent quality standards

References

1. Power Plant Engineering, P. K. Nag, Mc Graw Hill
2. Power Plant Engineering Technology, M.M. Wakil, Mc Graw Hil
3. Power plant engineering by ‘Arrora & Domkundwar’, Dhanpat Rai & Sons, New Delhi, 2008
4. Power plant engineering by ‘P C Sharma’, S.K. Kataria& Sons, New Delhi, 2010

MT104T – ELECTIVE- I - COMPUTER AIDED DESIGN AND ITS APPLICATIONS IN THERMAL SYSTEMS

UNIT-I

Introduction to CAD: basic structure of CAD system, Hardware and software for CAD, software modules, Geometric modeling, Solid modeling techniques. CAD/CAM exchange formats, surface manipulation techniques.

UNIT-II

Geometric Transformation: Two and three dimensional transformations, Curve representations analytic and synthetic curves, Bezier curve, modeling concepts Feature based modeling, Assembling modeling.

UNIT-III

One-Dimensional Analysis: Basic steps, discretization, element equation, linear and quadratic shape functions, Assembly, Local and global stiffness matrix and its properties, boundary conditions. Applications to heat and fluid mechanics problems.

UNIT-IV

Optimization: Statement of optimization problem, classification of optimization problems, one dimensional minimization methods, unconstrained and constrained optimization.

REFERENCES :

1. Ibrahim Zeid CAD/CAM Theory and practice, 2nd Edition Tata Mc Graw Hill, 2009.
2. Roger D F and Adams, JA Mathematical elements for computer Graphics, Tata Mc Graw Hill, 2008.
3. Rao S. S. The Finite Element methods in Engineering, 5th Edition, Elesevier 2011.
4. Reddy J. N. and Gartling D. K. The Finite element method in Heat transfer and fluid Dynamics 3rd Edition CRC press.
5. Kalyanmay Deb Optimization for Engineering Design
6. Rao S. S. Optimization theory and applications, Willey Eastern Ltd. 2nd Edition 2004.

Elective II - (open)

PGHPE201T: REFRIGERATION AND AIR CONDITIONING TECHNOLOGIES

Course Outcomes

1. Ability to carry out thermodynamic analysis of multi pressure, cryogenic and other non-conventional refrigeration systems.
2. Propose the selection and application of suitable / eco-friendly refrigerants.
3. Ability to carry out heat load calculations and design air conditioning systems.
4. Ability to design air handling system.

UNIT –I

Analysis of conventional refrigeration systems – Vapour Compression Refrigeration Systems and Advanced Vapour Absorption Refrigeration systems, Multi-pressure system and their thermal analysis, Multi evaporator systems and their analysis.

Refrigerant Nomenclature, mixture refrigerants, Ozone layer depletion and Global warming, Montreal and Kyoto Protocol, Alternatives to CFC's and HFC's.

UNT – II

Analysis of Non-conventional Refrigeration Systems- Steam jet refrigeration systems, Thermoelectric refrigeration system, Vortex tube refrigeration system, Pulse tube refrigeration system, Adsorption refrigeration system.

Cryogenic Applications- Gas liquification systems, storage and handling of Cryogens, cryogenic insulations.

UNIT - III

Advanced Psychrometry:

Application of psychrometry to various air conditioning system RSHF, GSHF, ESHF.

Heat Load Calculations:

Data collection for load calculation, various components of heat load estimate method of cooling load calculation.

UNIT - IV

Air Transmission and Distribution:

Principle of air distribution, types of grills and diffusers and their selection criteria, air altration, types of air filters, distribution of air through ducts, pressure losses in ducts, methods of duct design, duct friction chart, air conditioning controls.

PRACTICALS:

[Minimum seven experiments to be performed/demonstrated/studied]

REFERENCES :

1. Refrigeration and Air conditioning by C.P. Arora
2. Cryogenic System by R.F. Borron

3. Hanbook of Air Conditioning systems design by Carrier
4. Air Conditioning by Marries
5. ASHRAE Guide and Data Book.

PGHPE202T THERMAL ENGINEERING

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

1. *Understand the ideal and real thermodynalic cycles of air-breathing engines and industrial gas turbines.*
2. *Understand the combustion forces and design the combustion chamber of a gas turbine.*
3. *Understand the power plant components and analysis to improve the performance.*

Unit-I

Gas turbine classification of turbo machines, thermodynamic analysis of gas turbine cycles, intercooler reheater and regenerative cycles, performance of practical gas turbine cycles. Gas turbine combustion system. Pressure and hour losses, mechanical losses, loss due to incomplete combustion.

Unit- II

Power Plant Economics: Economic analysis of power plants and targets, Load curves, load duration curve, different terms and definitions; Effect of fluctuating load on operation and design of the plant, methods of meeting fluctuating load, cost of electrical energy; operating costs, generation costs, depreciation cost. Cost benefit analysis, Selection of type of generation; Performance and operating characteristics of power plants; Selection of the generating equipments, Combined operation of power plants; load division between stations, effect of load factor on energy cost, different types of tariffs. Exergy Analysis of simple steam power plant.

Unit-III

Co-Generation : Basic of thermodynamic cycle, operating strategies for co-generation plant, typical co-generation parameter, waste heat recovery , classification-benefits, development of a waste heat recovery system.

Unit-IV :

Analysis of power plant components : Classification of cooling tower, thermal analysis of cooling tower, design of cooling tower, factor affecting the design of cooling tower, determination of number of diffusion unit.

PRACTICALS:

[Minimum seven experiments to be performed/demonstrated/studied]

REFERENCES:

1. Cohen H; Rogers GFC, Sarvanamuttoo H. I., Gas Turbine Theory, Pearson Prentice Hall
2. Ganeshan V, Gas Turbine, Tata Mcgraw Hill
3. Wakil EL, Power Plant Technology, Tata Mcgraw Hill
4. Nag P. K., Power Plant Engineering, Tata McGraw-Hill publication.
5. Rathore M.M., Thermal Engineering, Tata McGraw-Hill publication.
6. Ibrahim Dincer, Rosen M.A., Exergy: Energy Environment & Sustainable Development, Elservier Science and Technology

PGHPE203T ADVANCED FLUID MECHANICS

Unit I: Fluid Flow Concepts, Continuum Model, Eulerian & Lagrangian Approach, Two-dimensional Potential flows - Different types of flow patterns, Basic scientific laws used in the analysis of fluid flow, Rotational and irrotational flow and condition for such flows, Stream function and potential function, Source, Sink and Doublet.

Unit II: Fundamental equations of motion and continuity applied to fluid flow, Relation between stress and rate deformation, Physical conservation laws, Integral and differential formulations, Navier-Stokes and energy equations, Solution of Navier-Stokes equations.

UnitIII: Boundary layer theory – Boundary layer concept, Boundary layer thickness, Boundary layer development over a flat plate and conduits, Flow separation in boundary layers, Blasius solution, Momentum integral approach, Boundary layer control and its application, Drag, pressure, shear stress and skin friction.

Unit IV: Turbulent flows – Reynolds equation, Reynold's transport theorem, Prandtl and von Karman hypothesis, Universal velocity profile near a wall- flow through pipes, Velocity distribution and friction factor for turbulent flow in pipes, Fluid power transmission through pipes, Semi-empirical theories of similarity hypothesis. Introduction to Computational fluid dynamics.

References

Kothandaraman C.P., Fluid mechanics and Machinery, 3rd ed., New age publishers 2011.

Kumar D.S., Fluid mechanics and Fluid power engineering, S.K. Kataria& sons Pub.

3. Currie LG., *Fundamental Mechanics of Fluids, 3rd* ed., CRC Press, 2002.
4. White P.M., *Viscous Fluid Flow, 2nd* ed., McGraw-Hill, 1991.
5. Ockendon H. and Ockendon J., *Viscous Flow*, Cambridge Uni. Press,1995.
6. Fluid Mechanics Douglas J.F. Gasiorek, &Swaffield J. A, Pearson publishers.

PGHPE204T Elective-III

HEAT EX-CHANGER ANALYSIS AND DESIGN

Course Objective: *To impart knowledge on theory and constructional details of various types heat exchangers and their design aspects.*

Unit-I

Basic design methods for heat exchanger- , Double Pipe Heat Exchangers - Film Coefficients of Fluids and Tubes - Equivalent diameter for fluids flowing in Annuli - Film coefficients for fluids in Annuli: Fouling factors - The Caloric or Average Fluid Temperature - Heat load - LMTD and NTU methods of evaluation of heat exchangers - The calculation of double pipe exchanger: Double pipe exchangers in series - parallel arrangements. Plate heat exchanger, Compact heat exchanger

Unit-II

Shell and Tube heat exchangers - Tube layouts for exchangers- Baffle spacing, different types of shell and tube exchangers - The calculations of shell and tube exchangers shell side film coefficients - shell side equivalent diameter - The true temperature difference in a 1-2 exchanger. Influence of approach temperature on correction factory - Shell- side pressure drop - Tube side pressure drop- Analysis of performance of 1-2 exchangers and design calculation of shell and tube heat exchangers - Flow arrangements for increased heat recovery - The calculations of 2-4 exchangers - TEMA standards.

Unit- III

Direct-contact heat exchanger: cooling towers relation between the wet-bulb and dew point temperatures - The Lewis number - Classification of cooling towers cooling-tower internals and the role of fill - Heat exchange heat transfer by simultaneous diffusion and convection - Analysis of cooling towers measurements - Design of cooling towers - Determination of the number of diffusion units - Calculation of cooling tower performance - The influence of process conditions upon design - The influence of operation tables.

Unit-IV

Heat pipes types and applications - Heat pipe operating principle - Working fluid - Wick selection and wick structures – Compatibility – Limitations - Design of circular heat pipes.

REFERENCES:

1. Donald Q.Kern, *Process Heat Transfer,* Tata Mc Graw-hill Publishing Company, Ltd.,
2. Hewitt, Shires and Bolt, *Process Heat transfer,* CRC Press
3. A.P.Frans and M.N.Ozisik, *Heat exchanger Design,* John Wiley & Sons New York
4. P.Dunn and D.A.Reay , *Heat Pipes,* Pergamom Press
5. G.P.Peterson, *Design of Heat Pipes*.

6. Compact Heat Exchangers by W. Kays and A. London, National Press.
7. Heat exchanger, Design, rating and Selection, Sadik Kakac, CRC Press
8. Heat Exchangers Thermal Hydraulic Fundamentals and Design by S.Kakac, A. , Bergles, F.Mayinger, McGraw-Hill Book Company.
9. Automotive Heating and Air Conditioning by Tom Birch, Prentice Hall
10. Power plant Engineering, P. K.Nag, Tata McGraw-Hill publication,

PGHPE204T – ELECTIVE-III- THERMAL STORAGE SYSTEM

Unit I: Introduction

Need of Energy Storage, Different modes of Energy Storage, Necessity of thermal storage, Thermal Storage Devices, Areas of Applications of thermal Storage, Heat Transfer Enhancement Methods

Unit II: Sensible Heat Storage system

Basic concept, Modeling of storage System, Water and rock bed storage- use of TRANSYS, Pressurized water storage in power plant, Packed bed storage, Stratified storage systems, Thermal storage in buildings, Earth storage, Energy storage in aquifers, Heat storage in SHS systems, Aquifers storage.Chemical Energy Storage, Thermo-Chemical, Bio-Chemical, Electro-Chemical, Fossil fuels and synthetic fuels and Hydrogen storage.

UnitIII: Regenerator

Parallel Flow, Counter Flow, Finite conductivity model, Non-linear Model, Transient Performance, Step Change in inlet gas temperature, Step Change in inlet gas Flow rate, Parameterization of Transient Response, Heat Storage exchangers.

Unit IV: Latent Heat Storage

Storage material modeling of phase change problem, Enthalpy Modeling, Heat Transfer Enhancement Configuration, Parameterization of Rectangular, Cylindrical Geometric Problems, Phase Change Materials(PCMs), Selection Criteria Of PCMs, Stefan Problem, Solar Thermal LHTES Systems, Energy Conservation Through LHTES Systems, LHTES Systems in Refrigeration and Air Conditioning Systems.

Applications: Food storage, Waste heat recovery, Solar energy storage, Green house heating, Drying and heating applications,Power Plant Applications, Drying and Heating for Process Industries.

References

1. F. W. Schmidt and A.J. Willimot, Thermal Storage and Regeneration, Hemisphere Publishing Corporation, 1981.
2. V. J. Liunardini, Heat Transfer in Cold Climate, D Van Nostrand Reinhold, NY, 1981.
3. Ibrahim Dincer and Marc A. Rosen, Thermal Energy Storage Syatem and Applications, Second Edition, A John Wiley and Sons, Ltd., Publication, 2011.

Foundation Course I:

III Semester M. Tech. (Heat Power Engineering)

Elective –IV (Open)

Foundation Courses –II

Project Seminar