FIRST YEAR MECHANICAL ENGINEERING (HEAT POWER)– CBCS PATTERN

SEMESTER - I

Sr. No	Course (Subject Title)	TEACHING SCHEME										EXAMINATION SCHEME											
		THEORY			TUTORIAL			PRACTICAL				THEORY				PRACTICAL				TERM WORK			
		Credits	No. of Lecture	Hours	Credits	No. of Lecture	Hours	Credits	No. of Lecture	Hours	Hours	Mode	Marks	Total Marks	Min	Hours	Mode	Marks	Marks	Hours	Max	Min	
1	MEHPE101	3	3	3	-	-	-	-	-	-		CIE ESE	30 70	100	40	As per BOS Guidelines		-	-				
2	MEHPE102	3	3	3	1	1	1	-	-	-		CIE ESE	30 70	100	40					1	25	10	
3	MEHPE103	3	3	3	-	-	-	-	-	-		CIE ESE	30 70	100	40			-	-				
4	MEHPE104 (E-I)	3	3	3	-	-	-	-	-	-		CIE ESE	30 70	100	40			-	-				
5	MEHPE105 (E-II)	3	3	3	-	-	-	-	-	-		CIE ESE	30 70	100	40								
6	MEHPE106		-	-	-	-	-	2	2	2							CIE ESE	25 25	10 10				
7	MEHPE107		-	-	-	-	-	1	2	2							CIE ESE	25 25	10 10				
8	MEHPE108		-	-	-	-	-	1	1	1		-	-	-	-		-	-	-	-	25	10	
	TOTAL	**15**	**15**	**15**	**1**	**1**	**1**	**4**	**5**	**5**				**500**				**100**			**50**		

SEMESTER –II

1	MEHPE201	3	3	3	-	-	-	-	-	-		CIE ESE	30 70	100	40	As per BOS Guidelines		-	-	-	-	-	
2	MEHPE202	3	3	3	-	-	-	-	-	-		CIE ESE	30 70	100	40			-	-	-	-	-	
3	MEHPE203	3	3	3	1	2	2	-	-	-		CIE ESE	30 70	100	40			-	-	1	25	10	
4	MEHPE204 (E-III)	3	3	3	-	-	-	-	-	-		CIE ESE	30 70	100	40			-	-	-	-	-	
5	MEHPE205 (E-IV)	3	3	3	-	-	-	-	-	-		CIE ESE	30 70	100	40			-	-	-	-	-	
6	MEHPE206	-	-	-	-	-	-	2	2	2							CIE ESE	25 25	10 10				
7	MEHPE207	-	-	-	-	-	-	1	2	2							ESE	50	20				

8	MEHPE208	-	-	-		-	-	-		1	1	1								-	-	-	-	25	10
	TOTAL	**15**	**15**	**15**		1	2	2		**4**	**5**	**5**					**500**				**100**			**50**	
	TOTAL	**30**	**30**	**30**		2	-	-		**12**	**8**	**8**					**1000**				**200**			**100**	

CIE- Continuous Internal Evaluation
ESE – End Semester Examination

• Candidate contact hours per week : 30 Hours (Minimum)	• Total Marks for M.Tech. SemI&II: **1300**
• Theory/Tutorial Duration : 60 Minutes and Practical Duration : 120 Minutes	• Total Credits for M.Tech. SemI&II: 40
• In theory examination there will be a passing based on separate head of passing for examination of CIE and ESE.	
• There shall be separate passing for theory and practical (term work) courses.	

SECOND YEAR MECHANICAL ENGINEERING – CBCS PATTERN

Sr. No	Course (Subject Title)	TEACHING SCHEME									EXAMINATION SCHEME												
		THEORY			TUTORIAL			PRACTICAL			THEORY						PRACTICAL			TERM WORK			
		Credits	No. of Lecture	Hours	Credits	No. of Lecture	Hours	Credits	No. of Lecture	Hours	Hours	Mode	Marks	Total Marks	Min	Hours	MODE	Max	Min	Hours	Max	Min	
SEMESTER –III																							
1	MEHPE301	-	-	-	-	-	-	2	-	-		CIE	-	-	-			-	-	-	50	20	
												ESE	-										
2	MEHPE302	-	-	-	-	-	-	2	5	5		CIE	-	-	-			-	-	-	50	20	
												ESE	-										
3	MEHPE303	-	-	-	-	-	-	8	5	5							CIE	50	20				
																	ESE	50	20				
	TOTAL	-	-	-	-	-	-	**12**	**5**	**5**				100				**100**			**100**		
SEMESTER –IV																							
1	MEHPE401	-	-	-	-	-	-	8	5	5		CIE		--			ESE	50	20	-	50	20	
2	MEHPE402							8	5	5		ESE					ESE	100	40				
	TOTAL	-	-	-	-	-	-	**16**	**5**	**5**				-				**150**			**50**	**50**	
	TOTAL	-	-	-	-	-	-	**28**		-				-									

CIE- Continuous Internal Evaluation

ESE – End Semester Examination

- Total Marks for M.Tech. Sem III&IV :**400**
- Total Credits for M.Tech. Sem III&IV: **28**
- In theory examination there will be a passing based on separate head of passing for examination of CIE and ESE.
- There shall be separate passing for theory and practical (term work) courses.

COURSE CODE AND DEFINITION

Semester I

Sr. No	Code No.	Subject	Credits
1.	MEHPE101	Advanced FluidMechanics	3
2.	MEHPE102	Advanced HeatTransfer	4
3.	MEHPE103	AdvancedThermodynamics andCombustion	3
4.	MEHPE104(E-I)	Elective – I	3
5.	MEHPE105(E-II)	Elective-II	3
6.	MEHPE106	Thermal Engg. Lab -I.	2
7.	MEHPE107	Instrumentation Lab	2
8	MEHPE108	*Seminar – I	2

Sr. No	Elective-I	Elective-II
1	Advanced I.C.Engine	Advanced Automobile Engineering
2	Advanced Refrigeration	Design of Air Conditioning Systems
3	Advanced Power Plant Engineering	Energy Analysis and Management

Semester II

Sr. No	Code No.	Subject	Credits
1.	MEHPE201	NumericalComputation of Fluidand Heat flow	3
2.	MEHPE202	Energy Analysis ofThermal Systems	3
3.	MEHPE203	Design of Heat TransferEquipments	4
4.	MEHPE204 (E-I)	Elective-III	3
5.	MEHPE205 (E-II)	Elective-IV	3
6.	MEHPE206	Thermal Engg. Lab. II	2
7.	MEHPE207	Comprehensive Viva	2
8.	MEHPE208	Seminar-II	2

Sr. No	Elective-III	Elective-IV
1	Design of Renewable Energy Equipments&Systems	Gas Turbines and Jet Propulsion
2	Cryogenics	Advanced Mathematical Methods andOptimization
3	** Open Elective	Design of Pumps, Compressors and Blowers

Semester III

Sr. No	Code No.	Subject	Credits
1.	MEHPE301	Inplant Traning	2
2.	MEHPE302	One Course from Moodle/Swayam	2
3.	MEHPE303	#Dissertation Phase-I	8

Semester IV

Sr. No	Code No.	Subject	Credits
1.	MEHPE401	#Dissertation Phase-II	8
2.	MEHPE402	#Dissertation Phase-III	8

Note :

*For seminar I and Seminar II, work load will be for two students.

#For Dissertation Phase I, Dissertation phase II and Dissertation Phase III work load will be for 6 students.

SHIVAJI UNIVERSITY, KOLHAPUR

M.Tech. Mechanical (Heat Power Engg.) – PART - I, SEM - I (CBCS)

MEHPE101 ADVANCED FLUID MECHANICS

Teaching Scheme: 3 Lectures/Week **Marks Scheme: CIE -30**

ESE - 70

Course Objectives:

1. To state and illustrate fundamentals of Fluid Statics, Kinematics and Dynamics.
2. To identify and explain the fluid properties and concepts of Boundary layer, Drag and Lift force.
3. To study the use of Bernoulli's Equation for various applications.
4. To understand the physics of fluid flow and its applications.
5. To get conversant with Internal, External flows and it's applications.

Course Outcomes:

1. Understand properties of fluids and classification of flows.
2. Formulate and solve equations of the control volume for fluid flow systems.
3. Calculate resistance to flow of incompressible fluids through closed conduits and over surfaces.
4. Apply fundamentals of compressible fluid flows to relevant systems.

1. **Concept of Continuum & Fluid:** Body and Surface Forces, Scalar and Vector fields, Eulerian and Lagrangian description of flow, Motion of Fluid element- Translation, Rotation & Velocity.

2. **Governing Equations**: Mass conservation in differential and integral forms, Flow kinematics, and Momentum equation: substantial derivative, differential and integral Form, stress tensor, stress strain relations, Ideal Fluid flow concepts.

3. **Mechanics of Laminar Flow:** Introduction Laminar and Turbulent flows, Viscous flow at different Reynolds number-wake frequency, Laminar plane Poiseuille flow, stokes flow, Flow through Concentric annulus, Laminar Flow in Pipes and Channels.

4. **Navier-Stokes Equations**: Special forms: Euler equations, Bernoulli equation, stream function, vorticity. Exact Solutions: fully developed flow in channel, pipe, flow between concentric rotating cylinders, Couette flow, Stokes First problem (unsteady flow), Creepingflow past a sphere, cylinder.

5. **Boundary Layers:** Boundary layer assumptions, equations, flow over a flat plate similarity (Blasius) solution, Falkner-Skan equation, momentum integral method external flows: drag, lift, flow separation

6. **Turbulent flow:** Introduction to hydrodynamic stability, characteristics of turbulence governing equations, turbulent boundary layer, algebraic models (Prandtl's mixing length), velocity profile over a flat plate and in pipes.

7. **Turbulent Shear Flows**: Equations for free shear layers: mixing layer, plane and axis symmetric jet, wake. Turbulent energy equation, two equation model(k-epsilon),Large Eddy Simulation, Various Turbulent Models
8. **Compressible Flow:** One-dimensional Flow: speed of sound, variable cross-section flow, converging diverging nozzle, effect of friction and heat transfer, normal shock relations, Introduction to oblique shocks, 2-dimensional flows(subsonic and supersonic) past slender bodies, compressible boundary layers.

BOOKS:

1. **Mohanty A.K.**-Fluid Mechanics,II edition, PHI private Ltd. New Delhi.
2. **E.Rathakrishnan-** Fluid Mechanics,II edition, PHI private Ltd. New Delhi.
3. **James A.Fay-**Introduction to Fluid Mechanics, PHI private Ltd. New Delhi.
4. **Streeter**-"Fluid Mechanics", Tata McGraw Hill, New Delhi.
5. **Schlichting**-Boundary layer theory,Springer Pub.
6. **G.Biswas and K. Muralidhar-** Advanced Fluid mechanics.
7. **F.M. White-** Viscous Fluid Flow. Tata McGraw Hill, New Delhi.
8. **Fox R.W. and McDonald A.T-** "Introduction to Fluid Mechanics" John Wiley & Sons.
9. **Bird R.B. Stewart W.F-**"Transport Phenomena", John Wiley & Sons.

SHIVAJI UNIVERSITY, KOLHAPUR

M.Tech. Mechanical (Heat Power Engg.) – PART - I, SEM - I (CBCS)

MEHPE102 ADVANCED HEAT TRANSFER

Teaching Scheme: 3 Lectures/Week **Marks Scheme: CIE -30**

ESE – 70

Course Objectives

1. Impart the advances knowledge of heat transfer.
2. Get analytical solutions for Dimensional steady and transient heat conduction problems.
3. Deep understanding on the governing equations for convection heat transfer and its application.
4. Understand the boiling and condensation mechanism.

Course Outcomes

1. Understand applications of classical heat transfer to practical problems.
2. Exhibit analytical and model synthesis skills needed to apply the fundamentals to a wide variety of complex engineering problems.
3. Design systems requiring significant consideration of heat transfer.

1. **Review of Basics of Heat transfer:** Differential Equation of Heat conduction in Cartesian conduction Cylindrical & Spherical coordinates of isotropic and anisotropic materials, Thermal conductivity variation with temperature for Solid, Liquid and Gases.

2. **Extended Surfaces:** Steady state analysis and optimization-Radial fins of rectangular and hyperbolic profiles-Longitudinal fin of rectangular profile radiating to free space, recent advances in Fins, their material and Heat Transfer enhancement Technique.

3. **Multi Dimensions steady state conduction** : Introduction, Mathematical analysis of two-dimensional Heat Conduction, Graphical Analysis, The conduction shape – factor, Numerical method of analysis, Gauss-Seidel Iteration, Electrical analogy for two – dimensional conduction.

4. **Unsteady state conduction:** Introduction, Lumped Heat Capacity system, Transient heat flow in a semi-finite solid, Convection Boundary Conditions, Multi-Dimensional system, Transient numerical method, Thermal resistance and capacity formulation, Graphical Analysis – The Schmidt plot, Micro scale heat transfer.

5. **Convection :** Laminar Boundary Layer on a flat plate energy equation of the Boundary layer, The thermal Boundary layer, The relation between Fluid friction and Heat transfer, Turbulent –Boundary Layer Heat transfer thickness, Heat transfer in laminar tube flow, Turbulent flow in a tube. Analogy for Laminar and Turbulent Flow, Empirical relations for pipe and tube flow, Flow across cylinders, spheres, Tube banks. Liquid metal heat transfer, Electronic Cooling, Transpiration Cooling and Ablasion Heat Transfer,

SECTION-II

6. **Natural Convection:** Free convection Heat transfer on a vertical flat plate, Empirical relations and flow field for free convection, free convection from vertical planes and cylinders, Horizontal plates and cylinders, inclined surface.
7. **Radiation:** Radiation mechanism, properties, Shape factor, Shields, Radiation heat exchange between non black bodies. Radiation network for an absorbing and Transmitting, Reflecting and absorbing media. Formulation for numerical solution, Thermal Radiations from a Luminous Fuel, Oil, gas and Flames, Radiation of Gases and vapour
8. **Heat exchangers:** Types of heat exchangers and applications,
9. **Condensation and Boiling:** Introduction, condensation heat transfer phenomena, the condensation number, Film condensation on inclined plates, vertical and horizontal tubes, sphere, tube banks. Condensation and Boiling enhancement Technique, Boiling Heat Transfer, Bubble dynamics and their heat transfer correlations for pool and flow boiling, Heat Pipes and their types, Recent advances in Heat Pipes.

TUTORIAL

Tutorials based on above syllabus.

BOOKS

1. **SaddikKakac**: Heat Conduction, McGraw-Hill Pub.
2. **S.P.Sukhatme:** Heat Transfer, Universities press.
3. **J.P. Holman,** Heat Transfer, McGraw-Hill Pub.
4. **A.J. Chapman:** Heat Transfer, Macmillan Publishing Co. New York.
5. **W.M.Kays and Crawford:** Convective Heat and Mass transfer, McGraw-Hill Co.
6. **Eckert and Drake:** Analysis of Heat Transfer, McGraw-Hill Co.
7. **Naylor:** Introduction to Convective Heat Transfer Analysis,
8. **Burmister**: Convective Heat Transfer,
9. **Incropera:** Fundamentals of Heat and Mass Transfer,
10. **Cengel:** Heat Transfer Practical Approach, McGraw Hills Co.
11. **P.K.Nag:** Heat Transfer, TATA McGraw-Hill Co.
12. **Bejan:** Convective Heat and Mass transfer

SHIVAJI UNIVERSITY, KOLHAPUR

M.Tech. Mechanical (Heat Power Engg.) – PART - I, SEM - I (CBCS)

MEHPE103 ADVANCED THERMODYNMICS AND COMBUSTION

Teaching Scheme: 3 Lectures/Week **Marks Scheme: CIE - 30**

ESE – 70

Course Objectives: Objectives of this course are

1. To provide the sufficient knowledge of thermodynamics to apply in real engineering problems
2. To familiarize the students about the thermodynamic relations and process and their use to analysis the given thermal application
3. To understand the gas equations for properties generation

Course Outcomes:

1 Understand properties of pure substances. Represent various processes on property diagrams, apply and compare equations of state for real gases

2 Derive Maxwell Relations, Clapeyrons Equation etc. and apply these for evaluation of thermodynamic properties.

3 Evaluate entropy change for flow and non-flow processes under steady and unsteady conditions.

4 Estimate thermodynamic properties of substances in gas or liquid state of ideal and real mixture.

5 Predict intermolecular potential and excess property behaviour of multi-component systems. Study irreversible processes.

SECTION-I

1. **Thermodynamics Relations:-** Mathematical theorems, Maxwell relations, T-ds equations, Energy Equations, General Relations involving internal energy, enthalpy & entropy, Thermodynamics Relations involving specific heat , Clapeyron equation, Joule Thomson Coefficient, Developing Tables of Thermodynamics properties from experimental data.

2. **Real Gases: -** Deviation from ideal gas behavior, equation of state for real gases, reduced properties, Generalizes equation of state, laws of corresponding states, Generalized compressibility charts, enthalpy deviation and entropy deviation charts and their applications, P-V-T surfaces of real substances, Fugacity and activity.

3. **Kinetic Theory of Gases:-** Postulates, concept of elastic collisions and mean free path, Derivation of ideal gas laws from kinetic theory, Distribution of molecular velocities, Maxwellion speeds and temperature, Law of equipartition of energy, Survival equation, Transport phenomenon.

4. **Statistical Thermodynamics:-** Fundamental Principles, Equilibrium distribution,Significance of Lagrangian Multipliers λ & β, Partition function, Equipartition of energy, Distribution of speeds in an Ideal monotomic gas, Statistical Interpolation of Work and Heat, Entropy & Information.

5. **Mixtures and Solutions:-** Dalton Model , Amagat Model, Simplified model of a mixture involving gases and a vapour, First law applied to Gas-Vapour mixtures, Adiabatic saturation process, Partial Molar properties, change in properties upon mixing, Thermodynamic properties relations for variable composition, Gibbs function and Enthalpy, Fugacity in a mixture, Ideal solution, Activity and Activity coefficient.

SECTION-II

6. **Chemical Reactions:-** Combustion process, Theoretical and actual combustion processes, Enthalpy of formation, Enthalpy of combustion, First law analysis of Reacting systems, Adiabatic flame temperature Enthalpy and internal energy of combustion, Entropy change of Reacting systems, Heat of reaction, Second law Analysis of Reacting systems, Evaluation of Actual combustion processes.

7. **Phase and Chemical Equilibrium:-** Equilibrium requirements, Equilibrium between two phases of a pure substances, Equilibrium of a multi-component , Multiphase system, Gibbs phase Rule, Meta stable Equilibrium, Chemical equilibrium, Simultaneous reactions, Ionization.

8. **Combustion basics:-**Reaction rates and first, Second and higher order reaction in gaseous, liquid and solid phases. Combustion and flame velocities, laminar and turbulent flames, premixed and diffusion flames, their properties and structures.

9. **Combustion Theories: -** Theories of flame propagation, thermal, diffusion and comprehensive theories, problems of flame stability, flashback and blow off. Combustion of solid, liquid and gaseous fuels. Combustion of fuel droplets and sprays.

10. **Combustion applications:-**Combustion system- combustion in closed and open systems, application to boiler, gas turbine combustors and rocket motors.

REFERANCE BOOKS

1. **V. Wylen& E. Sonntag.** "Fundamentals of Classical Thermodynamics" Wiley EasternLimited, New Delhi,
2. **J. P. Holman,** "Thermodynamics", McGraw Hill, London.
3. **Adrian Bejan, George T., Michael Moran,** "Thermal Design and Optimization" JohnWilley and Sons, Inc., pp 113-127, 1996.
4. **T.J. Kotas,** "The Energy Method of Thermal Plant Analysis", Butterworth, 1985
5. **J.L. Thrdkeld,** "Thermal environmental engineering", Prentice Hall, Inc. New Jersy.1970
6. **M.W. Zemansky,** "Heat and Thermodynamics",
7. **M.L. Mathur& S.C. Gupta,** "Thermodynamics for Engineers", Dhanpatrai and SonsLtd., New Delhi.
8. **Howell &Duckins,** "Fundamentals of Engineering Thermodynamics".
9. **Lee-Sears,** "Engineering Thermodynamics".

10. **N.A. Chigier,** Energy Combustion and Environment –McGraw-Hill 1981
11. **A. Murthy Kanury, Gordon and Breach,** Introduction to combustion phenomena,1975
12. **S. P. Sharma and Chandra Mohan,** Fuels and combustion –Tata McGraw –Hill. 1984.

SHIVAJI UNIVERSITY, KOLHAPUR

M.Tech. Mechanical (Heat Power Engg.) – PART - I, SEM - I (CBCS)

MEHPE104 ADVANCED I.C.ENGINES (ELECTIVE – I)

Teaching Scheme: 3 Lectures/Week **Marks Scheme: CIE - 30**

ESE - 70

Course Objectives

1. Understand design considerations in advanced IC Engine.
2. Learn optimization of engine components and prepare working drawings.
3. Learn design aspects of engine accessories and mountings.

Course Outcomes:

1. Design complete engine with all its components, mountings and accessories.
2. Quantify the effect of change in fuel on engine design and its performance.

1. SPARK IGNITION ENGINES

Air-fuel ratio requirements, Design of carburetor –fuel jet size and venturi size, Stages of Combustion-normal and abnormal combustion, Factors affecting knock, Combustion chambers, Introduction to thermodynamic analysis of SI Engine combustion process.

2. COMPRESSION IGNITION ENGINES

Stages of combustion-normal and abnormal combustion – Factors affecting knock, Direct and Indirect injection systems, Combustion chambers, Turbo charging, Introduction to Thermodynamic Analysis of CI Engine Combustion process.

3. ENGINE EXHAUST EMISSION CONTROL

Formation of NOX, HC/CO mechanism, Smoke and Particulate emissions, Green House Effect, Methods of controlling emissions, Three way catalytic converter and Particulate Trap, Emission (HC,CO, NO and NOx) measuring equipment's, Smoke and Particulate measurement, Indian Driving Cycles and emission norms

4. ALTERNATE FUELS

Alcohols, Vegetable oils and bio-diesel, Bio-gas, Natural Gas, Liquefied Petroleum Gas, Hydrogen, Properties, Suitability, Engine Modifications, Performance, Combustion and Emission Characteristics of SI and CI Engines using these alternate fuels.

5. RECENT TRENDS

Homogeneous Charge Compression Ignition Engine, Lean Burn Engine, Stratified Charge Engine, Surface Ignition Engine, Four Valve and Overhead cam Engines,

Electronic Engine Management, Common Rail Direct Injection Diesel Engine, Gasoline Direct Injection Engine, Data Acquisition System –pressure pick up, charge amplifier PC for Combustion and Heat release analysis in Engines.

TEXT BOOK:

1. **Heinz Heisler**, "Advanced Engine Technology", SAE International Publications, USA.
2. **Ganesan V.,** "Internal Combustion Engines", Third Edition, Tata Mcgraw-Hill

REFERENCES:

1. John B Heywood, "Internal Combustion Engine Fundamentals", Tata McGraw-Hill
2. Patterson D.J. and Henein N.A., "Emissions from combustion engines and their control", Ann Arbor Science publishers Inc, USA.
3. Gupta H.N, "Fundamentals of Internal Combustion Engines", Prentice Hall of India.
4. Ultrich Adler, "Automotive Electric / Electronic Systems", Robert Bosh GmbH.

SHIVAJI UNIVERSITY, KOLHAPUR

M.Tech. Mechanical (Heat Power Engg.) – PART - I, SEM - I (CBCS)

MEHPE104 ADVANCED REFRIGERATION (ELECTIVE – I)

Teaching Scheme: 3 Lectures/Week **Marks Scheme: CIE - 30**

ESE – 70

Course Objectives

1. To understand industrial refrigeration and air conditioning systems and their analysis
2. Impart knowledge of psychrometry and its application in air conditioning system design
3. Know how about controls in refrigeration and air conditioning

Course Outcomes:

1. Analyse performance of various refrigeration cycles and air conditioning systems
2. Identify suitable refrigeration system and propose design of the same
3. Design conventional or non-conventional air conditioning system for specific application

1. **Conventional Refrigeration Systems:** Multi-evaporator system; Multi expansion system; Cascade systems; study of P-h; T-s; h-s and T- h charts for various refrigerants, Concept of Heat Pump

2. **Vapour Absorption Refrigeration:** Standard cycle and actual cycle, thermodynamic analysis, Li-Br-water, NH3-water systems, Three fluid absorption systems, half effect, single effect, single-double effect, double effect, and triple effect system

3. **Refrigerants:** Refrigerant recycling, reclaim and charging, alternative refrigerants, refrigerant-lubricant mixture behaviour , ODP, GWP concepts

4. **Non-Conventional Refrigeration System (Principle and Thermodynamic Analysis only):** Thermoelectric refrigeration, thermo-acoustic refrigeration, adsorption refrigeration, Steam jet refrigeration, vortex tube refrigeration, and magnetic refrigeration.

5. **Refrigeration Equipment's:** Reciprocating, screw, Scroll and Centrifugal Compressor based on applications

6. **Evaporators:** Design & Selection**,** types, thermal design, effect of lubricants accumulation, draining of lubricants, selection and capacity control

7. **Condenser:** Design and selection, types, thermal design, purging, selection and capacity control Selection of\expansion devices, Design of refrigerant piping, refrigeration system controls and safety devices, Solenoid valves, suction and evaporator pressure regulators, Thermal Insulation

8. **Motor Selection:** Single phase, Three phase, Starters, Constant speed and Variable speed Drive

9. **Control & Instrumentation:** Refrigeration system controller, high pressure receiver, Thermal design of low pressure receiver, accumulator, Filters, driers, oil separators, relief valves, safety valves, high and low pressure cut out, thermostats, water regulators System controller.

10. **Cooling Load Estimation Equipment Selection and Design:** Component Balancing, Analysis of designed equipment (thermodynamic), cost analysis and feasibility analysis for designed equipments, tools and equipments used in refrigeration.

11. **Case studies** to be dealt with selection and design of various components for various Industrial refrigeration applications: Cold storage, Process applications - textile, Pharmaceuticals, chemical, transport, food preservation, dairy etc.

RECOMMENDED BOOKS:

1. R.J. Dossat, Principles of refrigeration, Pearson Education Asia
2. C.P. Arora, Refrigeration and Air-Conditioning
3. Stoecker and Jones, Refrigeration and Air-conditioning
4. Jordan and Priester, Refrigeration and Air-conditioning
5. A.R. Trott, Refrigeration and Air-conditioning, Butterworths
6. J.L. Threlkeld, Thermal Environmental Engineering, Prentice Hall
7. W.F. Stoecker, Industrial Refrigeration Handbook, McGraw-Hill
8. John A. Corinchock, Technician's guide to Refrigeration systems, McGraw-Hill
9. P.C. Koelet, Industrial Refrigeration: Principles, design and applications, b Mcmillan
10. ASHRAE Handbook (i) Fundamentals (ii) Refrigeration
11. ISHRAE handbooks
12. ARI Standards
13. Refrigeration Handbook, Wang, McGraw Hill, Int.
14. Refrigeration – Malhotra Prasad
15. Refrigeration Dr. S. N. Sapali PHI Pub.

SHIVAJI UNIVERSITY, KOLHAPUR

M.Tech. Mechanical (Heat Power Engg.) – PART - I, SEM - I (CBCS)

MEHPE104 ADVANCED POWER PLANT ENGINEERING (ELECTIVE-I)

Teaching Scheme: 3 Lectures/Week **Marks Scheme: CIE - 30**

ESE – 70

Course Objective:

1. To provide a knowledge about the analysis of various cycles used for power generation, Combustion, kinetics involved in combustion.
2. To impart knowledge about feed water circulation, working of FWH.

Course Outcome:

Students will have an idea about

1. The use of various cycles for power generation.
2. The types of turbine to be selected for power generation, etc

1. **Analysis of Steam Cycles:** Rankine cycle, Carnot cycle, mean temperature of heat addition,effect of variation of steam condition on thermal efficiency of steam power plant, reheating of steam, regeneration, regenerative feed water heating, feed water heaters, carnotization of Rankine cycle, optimum degree of regeneration, Super critical pressure cycle, steam power plant appraisal, Deaerator, typical layout of steam power plant, efficiencies in a steam power plant, Cogeneration of Power and Process Heat, Numerical Problems.

2. **Combined Cycle Power Generation:** Flaws of steam as working fluid in Power Cycle,Characteristics of ideal working fluid in vapor power cycle, Binary vapor cycles, coupled cycles , combined cycle plants, gas turbine- steam turbine power plant, MHD-steam power plant, Thermionic- Steam power plant, Numerical problems.

3. **Fuels And Combustion :** Coal, fuel oil, natural and petroleum gas, emulsion firing, coal – oiland coal – water mixtures, synthetic fuels, bio-mass, combustion reactions, heat of combustion and enthalpy of combustion, theoretical flame temperature, free energy of formation, equilibrium constant, effect of dissociation, Numerical problems.

4. **Combustion Mechanisms :** Kinetics of combustion, mechanisms of solid fuel combustion,kinetic and diffusion control, pulverized coal firing system, fuel-bed combustion, fluidized bed combustion, coal gassifiers, combustion of fuel oil, combustion of gas, combined gas fuel oil burners, Numerical problems.

5. **Steam Generators:** Basic type of steam generators, fire tube boilers, water tube boilers.Economizers, superheaters, reheaters, steam generator control, air preheater, fluidized bed boilers, electrostatic precipitator, fabric filters and bag houses, ash handling system, feed water treatment, deaeration, evaporation, internal treatment, boiler blow down, steam purity, Numerical problems.

6. **Condenser, Feed Water and Circulating Water Systems:** Need of condenser, direct contactcondensers, feed water heaters, circulating water system, cooling towers, calculations, Numerical Problems.

7. **Nuclear Power Plants:** Chemical and nuclear reactions, nuclear stability and binding energy,radioactive decay and half life, nuclear fission, chain reaction, neutron energies. Neutron flux and reaction rates, moderating power and moderating ratio, variation of neutron cross sections with neutron energy, neutron life cycle. Reflectors, Types of Reactor, PWR, BWR, gas cooled reactors. Liquid metal fast breeder reactor, heavy water reactors, Fusion Power reactors, Numerical problems.

8. **Hydro Electric Power Plant:** Introduction, advantages and disadvantages of water power,optimization of hydro – thermal mix, hydrological cycles, storage and pondage, essential elements of hydro electric power plant, comparisons of turbines, selection of turbines, Numerical problems.

REFERENCE BOOKS:

1. Power Plant Engineering - P.K. Nag, Tata McGraw-Hill Publications.
2. Power Plant Engineering - M.M. EI-Wakil, McGraw- Hill Publications
3. An Introduction to Power plant engineering, G.D.Rai, Khanna Publishers, III edition,2001
4. Hydropower development series, Vol.1-17, Norwejian Institute of Technology,1996/2005.
5. Combined cycle Gas and Steam Turbine Power Plants, Rolf H Kohlhofer, PennWell Books, 1991
6. Standard Handbook of Power plant Engineering, Thomas C Elliot, Robert C Swanekamp, Kao Chen,McGraw Hill Professional, 1997
7. Wet steam turbines for Nuclear Power plants, AleksanderLejzerovic, Penn Well Books, 2005.
8. TMI 25 Years Later: the Three Mile Island nuclear power plant accidentand its impact, Bonnie Anne Osif, Anthony Baratta, Thomas W Conkling, Penn State Press,2004.

SHIVAJI UNIVERSITY, KOLHAPUR

M.Tech. Mechanical (Heat Power Engg.) – PART - I, SEM - I (CBCS)

MEHPE105 ADVANCED AUTOMOBILE ENGINEERING (Elective-II)

Teaching Scheme: 3 Lectures/Week **Marks Scheme: CIE - 30**

ESE – 70

Course Objectives:

The course aims to:

1. Describe importance and advanced knowledge of automobile engineering.
2. Classify various automobile layouts and materials of bodies.
3. Demonstrate automobile systems, wheels and tyres and automobile electrical and electronic systems for understanding construction and working principle.
4. Enable students to analyze and solve problems on automobile system by focus and critical thinking.
5. Demonstrate use of recent sophisticated developments, techniques and skill to fulfil industrial needs by arranging industrial visit.

Course Outcomes:

1. Explain drive system of various automobile.
2. Distinguish various types of automobile lay outs as per drive given to wheels.
3. Identify types of automobile bodies and materials used for the same.
4. Demonstrate various automobile systems like Automotive Power system, power steering, power brakes and its construction and working.
5. Demonstrate various Prospects of Hybrid Vehicles, electronic controlled management system and its construction and working principle, sensors and actuators used in automobile.

1. **The Future Of The Automotive Industry**: Challenges and Concepts for the 21stcentury. Crucial issues facing the industry and approaches to meet these challenges. Fuel Cell Technology For Vehicles: What is fuel cell, Type of fuel cell, Advantages of fuel cell. Current state of the technology. Potential and challenges. Advantages and disadvantages of hydrogen fuel. Hybrid vehicles - Stratified charged/learn burn engines - Hydrogen engines - battery vehicles – Electric propulsion with cables - Magnetic track vehicles.

2. **Latest Engine Technology Features**: Advances in diesel engine technology. Direct fuel injection Gasoline engine. Diesel particulate emission control. Throttling by wire. Variable Valve Timing, Method used to effect variable Valve Timing. Electromagnetic Valves, Cam less engine actuation.

3. **42 Volt System**: Need, benefits, potentials and challenges, Technology Implications for the Automotive Power system; power steering, power brakes, windows, Automated systems; computer controlled front collision prevention, navigation, GPS etc. Computer Control for pollution and noise control and for fuel economy - Transducers and actuators -Information technology for receiving proper information and operation of the vehicle like optimum speed and direction.

4. **Electrical And Hybrid Vehicles:** Types of hybrid systems, Objective and Advantages of hybrid systems. Current status, Future developments and Prospects of Hybrid Vehicles Integrated Starter Alternator: Starts stop operation, Power Assist, Regenerative Braking. Advanced lead acid batteries, Alkaline batteries, Lithium batteries. Development of new energy storage systems. Deep discharge and rapid charging ultra capacitors.

5. **X-By Wire Technology**: Introduction to X-By Wire, Advantage over hydraulic systems, Use of Automotive micro controllers, Types of censors, Use of actuators in an automobile environment, Vehicles Systems: Constantly Variable Transmission, Benefits, Brake by wire, Advantages over power Braking System, Electrical assist steering, Steering by wire, Advantages of Steering by wire, Semi-active and fully-active suspension system, Advantages of fully active suspension system.

TEXT & REFERENCE BOOKS:

1. Heinz Heisler, "Advanced Vehicle Technologies", SAE International Publication.
2. Ronald K. Jurgen, "Electric and Hybrid Electric Vehicles", SAE International Publication
3. Daniel J. Holt, "42 Volt system", SAE International Publication
4. Electronic Braking, Traction and Stability control-SAE Hardbound papers.
5. Electronics steering and suspension systems- SAE Hardbound papers.
6. J.H. Johnson, "Diesel Paniculate Emission", SAE Hardbound papers.
7. Richard Stobart, "Fuel Cell Technologies for vehicles", SAE Hardbound papers.

SHIVAJI UNIVERSITY, KOLHAPUR

M.Tech. Mechanical (Heat Power Engg.) – PART - I, SEM - I (CBCS)

MEHPE105 DESIGN OF AIR CONDITIONING SYSTEMS (ELECTIVE-II)

Teaching Scheme: 3 Lectures/Week **Marks Scheme: CIE - 30**

ESE – 70

Course Objectives: Objectives of this course are

1. To provide the sufficient knowledge of concept, applications, importance of air conditioning
2. To familiarize the students about the air conditioning system design and its applications in real life situations
3. To learn the duct design and load calculation

Course Outcomes:

1 Demonstrate Air-conditioning processes and psychometric

2 Illustrate Ventilation, Necessity, Natural Ventilation, wind effect, Measurement of thermal comfort indices.

3 Formulate and solve problems of cooling, heating load calculations.

4 Design Air distribution, duct design for suitable problem.

5 Analyze Sound propagation, SPL, PWL, Sound Intensity, room acoustics and apply noise control techniques.

1. **Basic Air-conditioning Principles**: Review of Psychometric processes using chart, Air conditioning systems-VAV, All air systems, All water systems, Application & Safety in various industries like food,Pharma,Electronic,Paper,Paint,Metallurgy,Foundry,Hospitals,HotelAutomobile,Rail-Road & Aircraft

2. **Load Estimation**: solar heat gain, study of various sources of the internal and external heat gains, heat losses, etc. Methods of heat load calculations: Equivalent Temperature Difference Method, Cooling Load Temperature Difference and Radiance Method, Inside and outside design conditions, Use of load Estimation by software

3. **Air Distribution**: Fundamentals of air flow in ducts, pressure drop calculations, design ducts by velocity reduction method, equal friction method and static regain method, duct materials and properties, insulating materials, types of grills, diffusers, wall registers, etc. VAV.

4. **Acoustics & Noise Control**: Definitions of various terms like level, pitch, attenuation, frequency, sources of noise in air conditioning plants, design procedure for noise prevention, noise and vibration study and elimination techniques (description only).

5. **Ventilation and Infiltration**: Requirement of ventilation air, various sources of Infiltration air, ventilation and infiltration as a part of cooling load.

6. **Equipment Selection:** Performance& selection of compressors ,fans blowers, Pumps &cooling towers

7. **Direct and Indirect Evaporative Cooling**: Basic psychometric of evaporative cooling, types of evaporative coolers, design calculations, indirect evaporative cooling for tropical countries.

8. **Air Conditioning Equipment's and Controls**: Precooling , Chillers, Condensing units, Cooling coils, bypass factors, humidifiers, dehumidifiers, various types of filters, air washers, Thermostat, humidistat, cycling and sequence controls, modern control of parity, odor and bacteria, Air filtration- Study of different types of filters, BMS applications, Clean Air Practices

9. **Standards and Codes**: ASHRAE/ARI, BIS standards study and interpretation, ECBC, NBC codes

RECOMMENDED BOOKS:

1. ASHRAE Handbooks
2. ISHRAE Handbook.
3. Handbook of Air Conditioning System Design, Carrier Incorporation, McGraw Hill Book Co., USA.
4. Trane air conditioning manual,
5. Refrigeration and Air conditioning, ARI Prentice Hall, New Delhi.
6. Norman C. Harris, Modern air conditioning
7. Jones W. P., Air conditioning Engineering, Edward Arnold Publishers Ltd, London, 1984.
8. Hainer R. W., Control System for Heating, Ventilation and Air conditioning, Van Nastrand Reinhold Co., New York, 1984.
9. Refrigeration and Air conditioning- C P Arora, Tata McGraw Hill Publication, New Delhi.
10. McQuiston, Faye; Parker, Jerald; Spitler, Jeffrey 2000, Heating, Ventilating and Air Conditioning-Analysis
11. Refrigeration & Air-Conditioning by Dr.S.N.Sapli-PHI Publication

SHIVAJI UNIVERSITY, KOLHAPUR

M.Tech. Mechanical (Heat Power Engg.) – PART - I, SEM - I (CBCS)

MEHPE105 ENERGY ANALYSIS AND MANAGEMENT (Elective-II)

Teaching Scheme: 3 Lectures/Week **Marks Scheme: CIE -30**

ESE – 70

Course Objectives:

1. To understand the importance energy security for sustainable development and the fundamentals of energy conservation.
2. To introduce performance evaluation criteria of various electrical and thermal installations to Facilitate the energy management
3. To relate the data collected during performance evaluation of systems for identification of energy saving opportunities.

Course Outcomes:

1. To identify and describe present state of energy security and its importance.
2. To identify and describe the basic principles and methodologies adopted in energy audit of an utility.
3. To describe the energy performance evaluation of some common electrical installations and identify the energy saving opportunities.
4. To describe the energy performance evaluation of some common thermal installations and identify the energy saving opportunities
5. To analyze the data collected during performance evaluation and recommend energy saving Measure

1. **Energy Scenario:** World's production and reserves of commercial energy sources. India's production & reserves energy alternatives.

2. **Alternative energy sources and technologies:**

   (a) Solar Energy: Devices for thermal collection and storage. Thermal applications, liquid flat plate collectors, performance analysis, testing procedures, concentrating collectors-various types, orientation and tracking modes, performance analysis of cylindrical parabolic concentrating collector, effect of various parameters on collector performance.

   (b)Other Methods for Solar Energy/Wind Energy Utilization: Applications, Geothermal Resources. Geothermal Electrical Power Plants. Scope for Geothermal systems in India.

3. **Economical & Environmental Aspects of Alternatives:** Initial & annual costs, Definitions of annual solar savings, Life cycle savings, Present worth calculations, Repayment of loan in equal Annual instalments, Annual solar savings, Cumulative Solar Savings and life cycle Savings, Pay-back period, Environmental Problems Related with utilization of Geothermal and Wind energy.

4. **Energy Auditing:** Introduction, Types, Preliminary audit, Intermediate and Comprehensive audit, Procedure of auditing, Case studies and Recommendations.

5. **Energy Conservation:-** Importance, Principles, Planning for Energy Conservation- Electrical energy, Thermal energy, Human & animal muscle energy. Waste Recovery /Recycling, Cogeneration.

6. **Energy Management:** Energy Strategic Planning, Management of supply side, Elements, steps, flow. Management of Utilization side- Elements, transmission, Equipment and control systems, principles of Energy Management.

REFERENCES:

1. Solar Energy- S.P. Sukhatme,TataMcGraw Hill Pub. Co.ltd.,New Delhi.
2. Hand Book of Industrial Energy Conservation – S.DavidHik,Van. Nostrand Reinhold Co.New York.
3. Hand Book of Energy Technology- V.Daniel Hunt, Van.Nostrand Reinhold Co.New York.
4. Energy Technology, Non-conventional, Renewable& Conventional.-S.Rao&Dr.B.B. Parulekar, Khanna Publishers, Delhi.
5. Solar Energy- H.P.Garg& J. Prakash,TataMcGraw Hill Pub. Co.ltd.,Delhi

SHIVAJI UNIVERSITY, KOLHAPUR

M.Tech. Mechanical (Heat Power Engg.) – PART - I, SEM - I (CBCS)

MEHPE106 THERMAL ENGINEERING LAB - I

Tutorial/Practical: 2 Hr/Week **Term Work: 25 Marks**

TERM WORK (ANY SIX)

1. Determination Thermal conductivity of Liquids and gases.
2. Determination of Effectiveness in parallel and counter flow heat Exchanger.
3. Determination of heat transfer in Boiling and Condensation
4. Trial on multi compressor system
5. Study and trial on heat pump
6. Study and trial on cascade refrigeration system.
7. Design / simulation of Flow through duct.
8. Design / simulation of air conditioning system.
9. Design/Simulation of refrigeration systems.
10. Case study on Energy Audit.

Shivaji University, Kolhapur

M.Tech. Mechanical (Heat Power Engg.) – PART - I, SEM - I (CBCS)

MEHPE107 SEMINAR-I

Practical: 2hrs/week **Term Work:** 25 Marks

Seminar-I

May be preferably based on the literature survey on any topic relevant to heat power engineering (should be helpful for selecting a probable title of dissertation).

Each student has to prepare a write up of about 25-30 pages of "A4" size sheets and submit it in IEEE format in duplicate as the term work.

The student has to deliver a seminar talk in front of the teachers of the department and his classmates, the teachers, based on the quality of work and preparation and understanding of the candidates, shall do an assessment of the seminar internally. Some marks should be reserved for the attendance of a student in the seminars of other students.

SHIVAJI UNIVERSITY, KOLHAPUR

M.Tech. Mechanical (Heat Power Engg.) – PART - I, SEM - I (CBCS)

MEHPE108 INDUSTRIAL INSTRUMENTATION LAB

Practical: 2hrs/week **Term Work :** 25 Marks
Oral : 25 Marks

TERM WORK

1. Measurement and calibration of
   i) Pressure gauge and vacuum gauges
   ii) Thermocouple
   iii) Load cell and strain gauge
   iv) Dynamometers
   v) Flow meter
   vi) LVDT/RVDT
   vii) Hygrometer
   viii) Tachometer
   ix) Anemometer

2. Study and use of computerized data acquisition/ data logger system
3. Analysis of errors in measurement systems.
4. Experimental dynamic response characterization of first order/second order instruments
5. Simulation of dynamic response characteristics of first order/second order instruments using MATLAB® Simulink

SHIVAJI UNIVERSITY, KOLHAPUR

M.Tech. Mechanical (Heat Power Engg.) – PART - I, SEM - II (CBCS)

MEHPE201 NUMERICAL COMPUTATION OF FLUID FLOW HEAT FLOW

Teaching Scheme: 3 Lectures/Week **Marks Scheme: CIE - 30**

ESE – 70

Course Objectives

1. Understand the laws of fluid flow for ideal and viscous fluids.
2. Develop finite difference and finite volume discredited forms of the CFD equations.
3. Formulate explicit & implicit algorithms for solving the Euler Equation & Navier Stokes Equation.

Course Outcomes:

1. Explain the fundamental principles of fluid motion and their application to the analysis and solution of problem in fluid flow engineering.
2. Solve Fluid dynamic& Heat transfer problem using computational fluid dynamics.

1. **Introduction to CFD:**

   Computational approach to Fluid Dynamics and its comparison with experimental and analytical methods, Basics of PDE: Elliptic, Parabolic and Hyperbolic Equations

2. **Governing Equations:**

   Review of Navier-stokes Equation and simplified forms, Solution Methodology: FDM and FVM with special emphasis on FVM, Stability, Convergence and Accuracy

3. **Finite Volume Method:**

   Domain discretization, types of mesh and quality of mesh, SIMPLE, pressure velocity coupling,

4. Checkerboard pressure field and staggered grid approach Geometry Modeling and Grid Generation

5. Practical aspects of computational modeling of flow domains, Grid Generation, Types of mesh and selection criteria, Mesh Quality, Key parameters and their importance Methodology of CFDHT

6. Objective and importance of CFDHT, CFDHT for Diffusion Equation, Convection Equation and Convection- Diffusion Equation

7. Solution of N-S Equation for Incompressible Flows

8. Semi-Explicit and Semi-Implicit Algorithms for Staggered Grid System and Non Staggered grid System of N-S Equations for Incompressible Flows.

REFERENCE BOOKS:

1. Computational Fluid Dynamics, The Basic with applications by John A. Anderson, Jr., McGraw hill International editions, Mechanical Engineering series.
2. Numerical Methods in Fluid Flow & Heat Transfer by Dr.SuhasPatankar.
3. An Introduction to Computational Fluid Flow (Finite Volume Method), by H.K.Versteeg, W.Malalasekera, Printice Hall.
4. Computational Methods for Fluid Dynamics by Ferziger and Peric, Springer publication.
5. An Introduction to Computational Fluid Mechanics by Chuen-Yen Chow, Wiley Publication.
6. Computational Fluid Flow & Heat Transfer by Murlidhar and Sundarrajan, Narosa publication.

SHIVAJI UNIVERSITY, KOLHAPUR

M.Tech. Mechanical (Heat Power Engg.) – PART - I, SEM - II (CBCS)

MEHPE202 ENERGY ANALYSIS OF THERMAL SYSTEMS

Teaching Scheme: 3 Lectures/Week **Marks Scheme: CIE - 30**

ESE -70

Course Objective:

1. To provide an introduction to thermal system design, Exergy analysis.

2. Design of piping and pumping systems. Techno-commercial analysis.

Course Outcome:

1. To learn basic principles underlying piping, pumping, heat exchangers; modelling and optimization in design of thermal systems.
2. To develop representational modes of real processes and systems.
3. To develop Techno-commercial optimization concerning design of thermal systems.

1. **Introduction to Thermal System Design:** Introduction; Workable, optimal and nearly optimal design; Thermal system design aspects; concept creation and assessment; Computer aided thermal system design.

2 **Thermodynamic modeling and design analysis:** First and second law of thermodynamics as applied to systems and control volumes, Entropy generation; Thermodynamic model – Cogeneration system.

3 **Exergy Analysis :-** Exergy definition, dead state and Exergy components ; Physical Exergy – Exergy balance ; Chemical Exergy; Applications of Exergy analysis; Guidelines for evaluating and improving thermodynamic effectiveness.

4 **Heat transfer modeling and design analysis:-**Objective of heat transfer processes; Review of heat transfer processes involving conduction, convection and radiation and the corresponding heat transfer equations used in the design.

5 **Design of Piping and Pump Systems:** Head loss representation; Piping networks; Hardy – Cross method; Generalized Hardy – Cross analysis; Pump testing methods; Cavitation considerations; Dimensional analysis of pumps; piping system design practice.

6 **Thermo-economic analysis and evaluation:-**Fundamentals of thermo-economics, Thermo-economic variables for component evaluation; thermo-economic evaluation; additional costing considerations.

7 **Thermo-economic optimization:-** Introduction ; optimization of heatexchanger networks ;analytical and numerical optimization techniques ; design optimization for the co-generation system- a case study ; thermo-economic optimization of complex systems.

REFERENCE BOOKS:

1 **Thermal Design & Optimization** - Bejan, A., et al., John Wiley, 1996

2 **Analysis & Design of Thermal Systems** - Hodge, B.K., 2nd edition, Prentice Hall, 1990

3 **Design of Thermal Systems** - Boehm, R.F., John Wiley, 1987

4 **Design of Thermal Systems** - Stoecker, W.F., McGraw-Hill

SHIVAJI UNIVERSITY, KOLHAPUR

M.Tech. Mechanical (Heat Power Engg.) – PART - I, SEM - II (CBCS)

MEHPE203 DESIGN OF HEAT TRANSFER EQUIPMENTS

Teaching Scheme: 3 Lectures/Week **Marks Scheme: CIE -30**
ESE - 70

Course Objectives

1. Impart knowledge of sizing and designing of various heat exchangers using various methods
2. Learn performance analysis and maintenance aspects of heat exchanging equipments

Course Outcomes:

1. Customize sizing and/or designing of heat exchangers
2. Identify efficiency of conventional or compact heat exchangers for specific purpose

1. **Different Classification of Heat Exchangers**: Parallel flow, counter flow and cross flow; shell and tube and plate type; single pass and multipass, once through steam generators etc
2. **Design of Shell and Tube Heat Exchanger:** Thickness calculation, Tube sheet design using TEMA formula, concept of equivalent plate for analyzing perforated analysis, flow induced vibration risks including acoustic issues and remedies, tube to tube sheet joint design, buckling of tubes, thermal stresses
3. **Boiler Furnace Design:** Heat transfer in coal fired boiler furnace (gas side) – Estimation offurnace exit gas temperature, estimation of fin-tip temperature. Heat transfer in two phase flow-Estimation of inside heat transfer coefficient using Jens &Lottes equation and Thom's correlation. Estimation of pressure drop in two phase flow using Thom's method.
4. **Design of Steam Condenser and Evaporative Condensers:** Effect of tube side velocity onsurface area and pressure drop for various tube sizes (It involves estimation of tube side velocity, surface area and pressure drop for various tube sizes & Plot the graph) and estimation of shell diameter of steam condenser.
5. **Design of Fuel Oil Suction Heater, Design of Fuel Oil Heater, Design of Recuperative Air Pre Heater, Design of Economizer:** Design includes estimation of heat transfer area, pressure drop etc.Superheater and Reheater Design, Design of heat pipe
6. **Design of Cooling Tower :** Design of surface and evaporative condensers ,cooling tower,performance characteristics

TUTORIAL:

Eight to Ten Tutorials based on above syllabus

REFERENCE BOOKS:

1. **Process Heat Transfer -** D.Q. Kern, McGraw-Hill Publications
2. **Applied Heat Transfer -** V. Ganapathy, Penn Well Publishing Company, Tulsa,Oklahoma.
3. **Process Heat Transfer -** Sarit Kumar Das, A. R. Balakrishan, Alpha ScienceInternational, 2005.

SHIVAJI UNIVERSITY, KOLHAPUR

M.Tech. Mechanical (Heat Power Engg.) – PART - I, SEM - II (CBCS)

MEHPE204 DESIGN OF RENWABLE ENERGY EQUIPMENTS AND SYSTEM

(ELECTIVE-III)

Teaching Scheme: 3 Lectures/Week **Marks Scheme: CIE -30**

ESE -70

Course Objectives

1. Understand need, usefulness and feasibility of non conventional power plants in global as well as Indian context
2. Learn environmental and socioeconomic impacts of such power plants, alternate to traditional power plants.

Course Outcomes:

1. Understand power crunch and propose green solution to overcome it
2. Evaluate potential opportunities in non conventional power sector

1. Solar Energy

Present status of energy scenario. Renewable and non-renewable energy sources. Availability, limitations, application of solar energy.

2. Solar Radiation

Structure of the sun, energy radiated by the sun, angular relationship of earth, and sun position, measurement of solar radiation. Derivations and Numerical Problems

3. Design of Flat Plate Collectors and Solar Concentrator

Types and Design of constructional details of flat plate collector, energy simple equation and performance curves, selection of flat plate collector, Limitations of flat plate collectors,

Design of various types of concentrators: selection of various materials for concentrators and reflecting surfaces and designing.

4. Design of Solar Heating Systems

Solar water and space heating systems, passive solar heating systems, solar heating economics, solar air-heating systems, typical solar ponds.

Design of Various solar stills and selection, constructional details, Solar Energy Storage Systems, Design of solar photovoltaic system, materials used and their performance.

5. Wind Energy

Availability of wind, various types of windmills and their constructional details and performance study, Power generated by windmills. Offshore Windmills. Derivations and Numerical Problems. Design of wind mills and installation, operation and maintenance.

6. Tidal Energy

Tidal energy available in India, suitable locations, study of various tidal energy power plants, and characteristics of turbines required, Design of tidal energy power plants.

Chemistry of biogas generation variables affecting simple gas plants, types of digestoers their working and construction, application of biogas, use of bio-gas, case study of "Pura" village bio gas electricity generation". Design of Bio gas plants,

TEXT BOOK:

- Sukhatme S.P., " Solar Energy", Tata McGraw Hill Publishing Company Limited, New Delhi, 1994
- Rai G.D., "An Introduction to Power Plant Technology", Khanna Publishers, Third Edition, Delhi, 1996
- Bansal N K and others "Non-Conventional Energy Sources".
- S. Rao and Dr. B. B. Parulekar, Energy Technology, Khanna Publishers, New Delhi.

REFERENCE BOOKS:

- Krieth and Krieder, "Principles of Solar Engineering", Tata McGraw Hill Publishing Company Limited, New Delhi, 1994
- Wakil M.M., "Power Plant Technology", McGraw Hill International Book Company, 1984.
- Pai B.K., and Ramprasad M.S., "PowerGeneration through Renewable Sources of Energy".
- Garg H.P. and Prakash J., "Solar Fundamental and Application" Tata McGraw Hill Publishing Company Limited, New Delhi, 1997

SHIVAJI UNIVERSITY, KOLHAPUR

M.Tech. Mechanical (Heat Power Engg.) – PART - I, SEM - II (CBCS)

MEHPE204 CRYOGENICS (ELECTIVE-III)

Teaching Scheme: 3 Lectures/Week **Marks Scheme : CIE - 30**

ESE – 70

Course Objectives

1. Impart basic knowledge of low temperature generation, difficulties in maintaining low Temperature and solutions
2. Understand applications of cryogenic refrigeration
3. Understand storage of cryogenic liquids and equipments, instruments used

Course Outcomes:

1. Understand use of cryogenic systems, real-time difficulties in storing cryogenic liquids
2. Identify effects of various components on cryogenic system performance

1. **Refrigeration and Liquefaction Principals:**Joule Thomson effect and inversion curve;Adiabatic and isenthalpic expansion with their comparison.
2. **Properties of Cryogenic Fluids:**Properties of solids at cryogenic temperatures;Superconductivity.
3. **Gas Liquefaction Systems:** Recuperative – Linde – Hampson, Claude, Cascade,Heylandt, Kapitza, Collins, Simon; Regenerative – Stirling cycle and refrigerator, Slovay refrigerator, Gifford-McMahon refrigerator, Vuilleumier refrigerator, Pulse Tube refrigerator; Liquefaction of natural gas.
4. **Cryogenic Insulation:**Vacuum insulation, Evacuated porous insulation, Gas filledPowders and fibrous materials, Solid foams, Multilayer insulation, Liquid and vapour Shields, Composite insulations.
5. **Storage of Cryogenic Liquids:**Design considerations of storage vessel; Dewar vessels;Industrial storage vessels; Storage of cryogenic fluids in space; Transfer systems and Lines for cryogenic liquids; Cryogenic valves in transfer lines; Two phase flow in Transfer system; Cool-down of storage and transfer systems.
6. **Cryogenic Instrumentation:** Measurement of strain, pressure, flow, liquid level andTemperature in cryogenic environment; Cryostats.
7. **Cryogenic Equipment:** Cryogenic heat exchangers – recuperative and regenerative;Variables affecting heat exchanger and system performance; Cryogenic compressors, Pumps, expanders; Turbo alternators; Effect of component inefficiencies; System Optimization.
8. **Magneto-caloric refrigerator;** 3He-4He Dilution refrigerator; Cryopumping; CryogenicEngineering applications in energy, aeronautics, space, industry, biology, preservation Application of Cryogenic Engineering in Transport

RECOMMENDED BOOKS:

1. Cryogenics: Applications and Progress, A. Bose and P. Sengupta, Tata McGraw Hill.
2. Cryogenic Engineering, T.M. Flynn, Marcel Dekker
3. Handbook of Cryogenic Engineering, Editor – J.G. Weisend II, Taylor and Francis
4. Cryogenic Systems, R. Barron, Oxford University Press.
5. Cryogenic Process Engineering, K.D. Timmerhaus and T.M. Flynn, Plenum Press.
6. Cryogenic Fundamentals, G.G. Haselden, Academic Press.
7. Advanced Cryogenics, Editor – C.A. Bailey, Plenum Press.
8. Applied Cryogenic Engineering, Editors – R.W. Vance and W.M. Duke, John Wiley & sons.

SHIVAJI UNIVERSITY, KOLHAPUR

M.Tech. Mechanical (Heat Power Engg.) – PART - I, SEM - II (CBCS)

MEHPE204 OPEN ELECTIVE(ELECTIVE-III)

Teaching Scheme: 3 Lectures/Week **Marks Scheme : CIE - 30**

ESE - 70

Students of M.Tech.(Mech/HPE)-II, can take any subject from other discipline from post graduate course running in the same Institute in consent with their Guide and same should be intimated to Shivaji University, Kolhapur while filling up the Examination Forms

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SHIVAJI UNIVERSITY, KOLHAPUR

M.Tech. Mechanical (Heat Power Engg.) – PART - I, SEM - II (CBCS)

MEHPE205 GAS TURBINES & JET PROPULSION(ELECTIVE-IV)

Teaching Scheme: 3 Lectures/Week **Marks Scheme : CIE - 30**

ESE - 70

Course Objectives:

1. To Understand the concept of gas dynamics
2. To familiarize the students about the Jet and rocket propulsion and its whole thermodynamics analysis
3. To understand the applications of Jet propulsion

Course Outcomes:

1 Apply knowledge of features and capabilities of chemical and non-chemical rocket Propulsion systems.

2 Calculate the design thrust and overall efficiency of turbojet and turbofan engines, with and without afterburners, from given component performance.

3 Calculate the specific impulse and mass flow for a rocket engine with the fluid considered as an ideal gas with constant specific heats.

4 Estimate the specific impulse and mass flow for a rocket engine accounting for chemical reaction and non-constant specific heats.

5 Estimate the heat transfer rates in rocket nozzles and in aero-engine turbine components.

6 Design simple rocket propulsive system.

1. **Introduction**: Historical development, comparison with reciprocating I.C. Engines.Applications of gas turbine power plants.
2. **Thermodynamics Cycles For Gas Turbines**: Air standard Brayton cycle, Calculation of thethermal efficiency, cycle air rate, cycle work-ratio, optimum pressure ratio for maximum work output of the cycle. Simple open cycle gas turbine.Modification of gas turbine cycle with inter-cooling, reheating and regeneration and effect on thermal efficiency and specific output.Closed cycle gas turbine and semi-closed cycle gas turbine. Their comparison with open cycle, Co generative power plant(Numerical problems to be taught)

3. Compressors

Types commonly used for gas turbine power plants. (Numerical problems to be taught)

a. **Centrifugal Compressors:** Principal of operation, work done and pressure rise. Vane-less space, slip factor, power input factor and Mach number at intake to impeller.

b. **Axial Flow Compressors:** Working principal, work done degree of reaction, poly-tropic efficiency, overall performance of the compressors

4. Fuels and Combustion Chambers

Requirement of combustion chamber, combustion process, pressure loss and pressure lossfactor. Combustion chamber geometry and types. Solid, liquid and gaseous fuels used for gas turbine power plants. Fuel burning arrangements and ignition

5. Turbines: Impulse and reaction turbines, turbine efficiencies, nozzle efficiency, bladeefficiency, mechanical and overall efficiency. Theory of impulse and reaction turbines, number of stages and limitations. Constructional details of shafts, bearings, blades and casings. Coolingofblades, Lubricationand governing ofturbines. Maintenanceand troubleshooting (Numerical problems to be taught)

6. Materials For Gas Turbine: Factors influencing selection of materials,materials used fordifferent component like compressor component,combustion chamber, disc and rotors, turbineblades, nozzle guide vanesturbine casing and heat exchanges

7. Component Machining And Performance Evaluation: Performance characteristics, dimensionless numbers linking component Equilibrium points and procedure to find it transient operation

8. Jet Propulsion and Rocket Propulsion: Theory of jet propulsion features and types of different jet engines performance efficiencies and applications, Types of rocket power plants and their application(Numerical problems to be taught)

REFERENCES BOOKS:

1. **"Gas Turbine Theory"**, H.Cohen, GFC Rezers and HIH Saravanamutto.
2. **"Jet Air Craft Power Systems"**, Jack Casamassa, Ralph Bent.
3. **"Gas Turbine"**, V. Ganesan
4. **"Gas Turbine and Propulsion System",** P.R. Khajuria and S.P. Dubey
5. Vincent **"The Theory and Design of Gas Turbines and Jet Propulsion"**McGraw-Hill Publication.
6. W.W.Battic**"Fundamentals of Gas Turbines"** John Wily& Sons.
7. Jack D.Mattingly**"Elements of Gas Turbines and Propulsion"** McGraw-Hill Publication.

SHIVAJI UNIVERSITY, KOLHAPUR

M.Tech. Mechanical (Heat Power Engg.) – PART - I, SEM - II (CBCS)

MEHPE205 ADVANCED MATHEMATICAL METHODS AND OPTIMIZATION

(ELECTIVE-IV)

Teaching Scheme: 3 Lectures/Week **Marks Scheme: CIE - 30**

ESE – 70

Course Objectives :

1. To impart knowledge on numerical methods that will come in handy to solve numerically the problems that arise in Thermal Engineering.
2. To serve as a precursor for future research

Course Outcomes:

1. Able to identify and use suitable numerical method to address live engineering problem

1. **Linear Algebraic Equations:** Gauss – Elimination, Gauss – Seidel, LU Decomposition.
2. **Roots of Equations:**Bisection Method, False position method, Newton – Raphson Method, Muller's method, Bairstow's Method.
3. **Curve fitting – Least Square Regression:**
   i) Linear regression, multiple linear regressions, polynomial regression.
   ii) Non linear regression – Gauss – Newton method, multiple nonlinearregressions.
4. **Interpolation:** Newton's Divided Difference, Lagrange's Inverse, Spline,HermiteInterpolation, Extrapolation technique of Richardson's Gaunt.
5. **Differentiation & Integration:** Divided difference formulae, Romberg integration, Gauss quadrature for double & triple integration.
6. **Eigen Values & Eigen Vectors of Matrices:**Faddeev- Laeverrier's method, Power Method, Householder & Given's method
7. **Ordinary Differential Equations:** Euler's method, Heun's method, Mid – point method, Runge – Kutta methods, Multi step Methods - explicit Adams – Bashforth technique & Implicit Adams – Moulton Technique, Adaptive RK method, Embedded RK method, step size control. Higher order ODE – Shooting method. Nonlinear ODE– Collocation technique.
8. **Partial Differential Equations:** Solution of Parabolic and Hyperbolic equations – Implicit & Explicit Schemes, ADI methods, Non linear parabolic equations-Iteration method. Solution of elliptic equation – Jacobi method, Gauss – Seidel & SOR method. Richardson method.Numerical methods should have orientation in thermal and fluid engineering

REFERENCES:

1. **Numerical Methods for Engineers**, Steven C Chapra& Raymond P Canale, TMH, Fifth Edition
2. **Applied Numerical Methods**, AlkisConstantinides, McGraw Hill
3. **Numerical Solution of Differential Equations**, M.K. Jain, 2nd Edition, Wiley Eastern.
4. **Numerical Methods for Scientific and Engineering Computation, Jain**, Iyangar,Jain, New Age International Publishers.
5. **Numerical Methods in Engineering and Science**, Dr. B.S. Garewal, Khanna Publishers.

SHIVAJI UNIVERSITY, KOLHAPUR

M.Tech. Mechanical (Heat Power Engg.) – PART - I, SEM - II (CBCS)

MEHPE 205 DESIGN OF PUMPS, COMPRESSORS AND BLOWERS

(ELECTIVE-IV)

Teaching Scheme: 3 Lectures/Week **Marks Scheme : CIE - 30**

ESE – 70

Course Objectives:

1. To provide the sufficient knowledge of concept, applications, importance of pumps blower and compressors
2. To familiarize the students about the Pumps blowers and compressors and their applications in real life situations
3. To understand the industrial applications of Pumps blowers and compressors

Course Outcomes:

1 Demonstrate Law of momentum, Vortex theory of Euler's head. Hydraulic performance of pumps, Cavitations.

2 Design of centrifugal pumps, axial flow pump and analyze their performance using engineering software's etc.,

3 Study types of fans and blowers, calculate their efficiency, stresses, and characteristics, draw performance characteristics.

4 Modelling of cooling tower fans Surging Design of blowers and fans.

5 Demonstrate and interpret performance analysis of Axial flow and centrifugal flow Compressors.

- **Centrifugal and Axial Flow Pumps:** Law of momentum, Vortex theory of Euler's head. Hydraulic performance of pumps; Cavitation, Jet pumps. The centrifugal pump, definitions, pump output and efficiency, multistage centrifugal pumps, axial flow pump, Design of pumps,
- **Power Transmitting Turbo-machines:** Introduction, theory, fluid of hydraulic coupling,torque converter.
- **Rotary Fans and Blowers:**Introduction, Centrifugal blower, types of Vane shapes, Size andspeed of Machine, Vane shape: efficiency, stresses, and characteristics. Actual performance characteristics, the slip co-efficient, Fan laws and characteristics.
- **Turbo blowers and their characteristics**. Cooling tower fan, Surging Design of blowersand fans.

- **Axial Compressors:** Stage velocity triangles, enthalpy – entropy diagrams, flow throughblade rows, stage losses and efficiency, work done factor, low hub-tip ratio stages, supersonic and trans sonic stages, performance characteristics, problems and design.
- **Centrifugal Compressors:** Elements of centrifugal compressor stage, stage velocitydiagrams, enthalpy-entropy diagram, nature of impeller flow, slip factor, diffuser, volute casing, stage losses, performance characteristics, problems and design.

TEXT / REFERENCES:

1. A.J.Stepanoff, Centrifugal and Axial /flow Pumps, Wiley, 1962.
2. A.Kovats, Design and Performance of Centrifugal and Axial Flow Pumps and Compressors, Oxford, Pergamon, 1958.
3. V. KadambiandManohar Prasad: "An Introduction to energy conversion VolumeIII,2002
4. S M Yahya: "Turbines, Compressors and Fans", Second Edition.
5. V Ganesan: "Gas Turbines", 2002.

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M.Tech. Mechanical (Heat Power Engg.) – PART - I, SEM - II (CBCS)

MEHPE206 THERMAL ENGINEERING LAB- II

Tutorial/Practical: 2 Hr/Week **Term Work: 25 Marks**

Oral: 25 Marks

TERM WORK (ANY SIX)

1. Design/Simulation of a thermal system such as gas turbine systems, steam power plants
2. Design/Simulation of thermal system components such as nozzles, heat Exchanger etc.
3. Design/Simulation of pumps or compressors.
4. Trial on thermal system and its validation.
5. Design of Condenser.
6. Design / simulation of Compressor.
7. Design of heat exchanger.
8. Design / simulation of solar thermal system.
9. Modeling of regenerative heat exchanger.
10. Case study on heat load calculation

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M.Tech. Mechanical (Heat Power Engg.) – PART - I, SEM - II (CBCS)

MEHPE 207 SEMINAR-II

Practical: 2hrs/week **Term Work:** 25 Marks

Seminar II shall be based on tentative topic of dissertation such as review paper on some specific well defined area/ specialized stream of Mechanical Engineering.

Each student has to prepare a write up of about 25-30 pages of "A4" size sheets and submit it in IEEE format in duplicate as the term work.

The student has to deliver a seminar talk in front of the teachers of the department and his classmates the teachers, based on the quality of work and preparation and understanding of the candidates, shall do an assessment of the seminar internally. Some marks should be reserved for the attendance of a student in the seminars of other students.

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M.Tech. Mechanical (Heat Power Engg.) – PART - I, SEM - II (CBCS)

MEHPE 208 COMPREHENSIVE VIVA

Oral:50 Marks

The students have to prepare on all subjects which they have studied In Ist and IInd semesters.

The viva will be conducted by the external/internal examiner jointly and their appointments will be made by university.

The in-depth knowledge, preparation and subjects understanding will be assessed by the Examiners.

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M.Tech. Mechanical (Heat Power Engg.) – PART - II, SEM - III (CBCS)

MEHPE 301 In-Plant Training

Term Work: 50

The student has to prepare the report of training undergone in the industry during vacation after semester II. It shall include the brief details of assignment completed by the candidate and general observation and analysis. The identified areas for undertaking the dissertation work shall form part of report. The term work marks be based on report and departmental oral exams. The training should be of minimum two weeks from reputed industries and certificate of the same should be part of report.

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M.Tech. Mechanical (Heat Power Engg.) – PART - II, SEM - III (CBCS)

MEHPE 302 DISSERTATION PHASE-I

Tut./Pract.: 5hrs per week **Term Work:**25 marks

The term work under this submitted by the student shall include.

1) Work diary maintained by the student and countersigned by his guide.

2) The content of work diary shall reflect the efforts taken by candidates for

   a) Searching the suitable project work.

   b) Visits to different factories or organizations.

   c) The brief report of feasibility studies carried to come to final conclusion.

   d) Rough sketches.

   e) Design calculations etc. carried by the student.

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M.Tech. Mechanical (Heat Power Engg.) – PART - II, SEM - III (CBCS)

MEHPE 303 DISSERTATION PHASE-II

Tut./Pract.:5hrs per week

Term Work: 50 marks
Oral : 25 marks

The term work under this submitted by the student shall include.

1) The student has to make a presentation in front of panel of experts in addition to guide as decided by department head.

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M.Tech. Mechanical (Heat Power Engg.) – PART - II, SEM - IV (CBCS)

MEHPE401 DISSERTATION PHASE-III

Tut./Pract.:5hrs per week **Term Work:** 100 marks

The term work under this submitted by the student shall include.

1) Work diary maintained by the student and countersigned by his guide.
2) The content of work diary shall reflect the efforts taken by candidates for
    a) Searching the suitable project work.
    b) Visits to different factories or organizations.
    c) The brief report of feasibility studies carried to come to final conclusion.
    d) Rough sketches.
    e) Design calculations etc. carried by the student.
3) The student has to make a presentation in front of panel of experts in addition to guide as decided by department head.

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M.Tech. Mechanical (Heat Power Engg.) – PART - II, SEM - IV (CBCS)

MEHPE402 DISSERTATION PHASE-IV

Tut./Pract.: 5 hrs per/week

Exam Scheme:

Term Work: 100 marks
Oral Exam : 100 marks

The dissertation submitted by the student on topic already approved by university authorities on basis of initial synopsis submitted by the candidate, shall be according to following guide lines.

Format of Dissertation Report:

The dissertation work report shall be typed on A4 size bond paper. The total No. of minimum pages shall not less than 60. Figures, graphs, annexure etc be as per the requirement.

The report should be written in the standard format.

1. Title sheet
2. Certificate
3. Acknowledgement
4. List of figures, Photographs/Graphs/Tables
5. Abbreviations.
6. Abstract
7. Contents.
8. Text with usual scheme of chapters.
9. Discussion of the results and conclusions
10. Bibliography (the source of illustrative matter be acknowledged clearly at appropriate place IEEE/ASME/Elsevier Format)