Course Name Thermal Power Engineering

Course Code ME(EE)301

Course Credit 3

Contact Hour 3L

Prerequisite

Course Objective

The course objectives are:

1. Describe sources of energy and types of power plants.
2. Analyze different types of steam cycles and estimate efficiencies in a steam power plant.
3. Define the performance characteristics and components of such power plants.
4. Describe different types of fuels used in power plants and estimate their heating values.
5. Describe principles of operations, components and applications of steam turbines, steam generators, condensers, feed water and circulating water systems.
6. Estimate efficiencies of boiler and performance of boiler.
7. Describe basic working principles of gas turbine and diesel engine power plants.
8. Estimate different efficiencies associated with such systems.
9. Define terms and factors associated with power plant economics.
10. Calculate present worth depreciation and cost of different types of power plants.
11. Estimate the cost of producing power per kW.
12. Estimate different efficiencies of I.C Engine and describe the different parameters of performance test of an I.C Engine.

Course Outcome

On completion of the course students will be able to

1. Discuss the energy resources and energy conversion methods available for the production of electric power in India
2. Determine the efficiency and output of a modern Rankine cycle steam power plant from given data, including superheat, reheat, regeneration, and irreversibility's
3. Calculate the heat rate, fan power consumption, flame temperature and combustion air requirements of conventional steam generators (boilers).
4. Select the heat transfer tubes needed for condensers and feed water heaters
5. Explain the blade shapes, and calculate work output of typical turbine stages.
6. Calculate the performance of gas turbines with reheat and regeneration, and discuss the performance of combined cycle power plants.
7. Perform the preliminary design of the major components or systems of a conventional or alternate power plant.
8. Calculate the performance of I.C Engine with different efficiency and discuss the all other performance parameters of I.C Engine.

CO Mapping with departmental POs

H: High, M: Medium, L: Low

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	H	M	M	M	L	M	L	L	L	L	L	M
CO 2	H	M	M	M	M	H	H	M	M	L	H	H
CO 3	H	M	M	L	H	L	M	L	L	L	L	H
CO 4	H	M	M	M	L	M	H	L	M	L	M	M

CO 5	H	M	M	M	M	H	M	M	M	M	M	H
CO 6	H	M	M	M	L	M	H	L	L	M	L	M
CO 7	H	M	M	M	M	H	H	M	L	H	L	M
CO 8	M	H	H	L	M	M	M	M	L	H	H	H

Course Content:

Module I: 9L

Boilers – Its function, classification – Water tube and Fire tube boilers. Circulating principles – Natural circulation and circulation ratio (CR) Forced circulation, critical pressure. Boiler accessories: Super heaters, Reheaters, Economiser, Air preheater. Boiler steam generation rate control: Feed water and Drum level control. Boiler Pressure control: Working principle. Steam temperature control: Combined radiant convective superheater, Desuperheating and Attemperation. Super critical boiler. Boiler Performances analysis and heat balance. Simple vapour power cycle - Rankine Cycle, Cycles for modern steam plants-Ideal reheat cycle. Draught – its classifications – natural draught, artificial draught. Calculation of Chimney height and diameter, Condition for maximum discharge through the chimney.

Module II: 5L

Thermodynamics of compressible fluid flow – Definition of steam nozzle, equation of continuity. Isentropic flow through nozzle (accelerated flow, decelerated flow and constant velocity flow). Mass of Steam discharged, critical pressure ratio for adiabatic frictionless expansion of steam. Physical explanation of critical pressure ratio, chocked flow. Nozzles operating under off the design condition, supersaturated flow through nozzles.

Module III: 5L

Rotary thermodynamics devices – Steam turbines – Principle of operation (Impulse). Classification of turbines – Simple impulse turbine, Pressure compounded impulse turbine, Velocity compounded impulse turbine, Pressure – Velocity compounded turbine. Performance analysis of simple impulse turbine, velocity compounded: velocity diagrams, blade or diagram efficiency, power developed, optimum velocity ratio**.** Steam turbine performance analysis for pressure compounded turbine: reheat factor, internal efficiency and stage efficiency. Turbine losses, Governing of turbines.

Module IV: 6L

IC Engines – classifications – Analysis of air standard Cycles (Otto cycles, Diesel Cycles and Dual Cycles).Four stroke engine – working principle, valve timings, and Engine performance: engine power, engine efficiency, indicated mean effective pressure, brake mean effective pressure. Testing of IC engine, heat balance. Combustion phenomenon in SI and CI engine. Fuel Characteristics of SI & CI engine. Automotive engine exhaust emission and their control.

Module V: 4L

Gas Turbine–Closed and open cycle gas turbine, Basic close cycle gas turbine: Machine efficiencies, Optimum pressure ratio for maximum specific output, Optimum pressure ratio for maximum cycle efficiency. Open cycle Gas turbine: application and its working principle, Gas turbine cycles with heat exchanger or regenerator, Gas turbine cycles with intercooler and reheating. Performance analysis of gas turbine cycle - Isentropic efficiency and combustion Efficiency, mechanical efficiency etc

Text Book

1. P.K.Nag- Engineering Thermodynamics – TMH ,2/e
2. P K Nag- Power Plant Engg. - TMH Pub
3. P.S. Ballaney- Thermal Engineering – Khanna Pub
4. Domkundwar & Arora- Power Plant Engineering –.Dhanpat Rai & Co.
5. A Text Book of Power Plant Engineering – R. K. Rajput – Laxmi Publications (P) Ltd

Reference Book

1. Cengel --- Thermodynamics , 3/e ,TMH
2. Et-Wakil—Power Plant Engineering , MH
3. M W Zemansky & R.H.Dittman -Heat and Thermodynamics – McGraw Hill ,7/e