MEPE3006 POWER PLANT ENGINEERING (3-0-0)

Course Objectives

The objectives of this course are to:

- Provide fundamental knowledge of various power generation methods and thermodynamic cycles.
- Explain the working principles, construction, and performance of essential components of modern thermal power plants.
- Discuss the design and operational aspects of different types of power plants including steam, nuclear, hydroelectric, and diesel.
- Enable students to analyze the efficiency and performance of steam turbines, nozzles, condensers, and cooling systems.
- Develop awareness of modern trends in combined cycle systems, environmental impacts, and energy sustainability.

Module - I (04 Hours)

Vapor Power cycle: Carnot cycle, Rankine cycle, Reheat cycle, Regenerative cycles, Combined cycle.

Module - II (06 Hours)

Steam Generators: Types of Steam Generators, Fire-tube Boilers, Water-Tube Boilers, Pulverised Coal Burners, Principle of Fluidised Bed Combustion (FBC) System, Combined Cycle power plant: Coal based combined plant, Integrated gasification (IGCC), Performance of Boilers.

Module - III (06 Hours)

Nozzle: Types of nozzles, Flow of steam through nozzles, Supersaturated or metastable expansion of steam in a nozzle.

Module - IV (06 Hours)

Steam Turbine: Classification of steam turbines, Impulse turbine, reaction turbine, Turbine efficiencies, Energy losses in steam turbines, Steam turbine governing and control.

Module - V (06 Hours)

Condensers: Classification of condensers, Jet condenser, surface condenser, Air leakage, Vacuum efficiency, Condenser efficiency, Circulating Water System, Cooling Towers, Cooling Tower Calculations.

Module - VI (10 Hours)

Diesel Power Plants: General layout, Components of Diesel engine power plant, Application of diesel engines in power field, Advantages and disadvantages, Performance characteristics, Nuclear Power Plant: Release of nuclear energy, Criticality of reactors, Thermal reactors, nuclear fuels, Moderator, Reflector, Coolant and control of reactors, BWR, PWR and gas cooled reactors. Hydroelectric Power Plant: Hydrological Cycle, Hydraulic Turbines.

Course Outcomes:

CO1 Explain the working principles of vapor power cycles including Rankine, Reheat, Regenerative, and Combined Cycles.

CO2 Describe the construction and operating principles of steam generators, nozzles, turbines, and condensers used in thermal power plants.

CO3 Analyze the performance and efficiency of steam turbines, condensers, and cooling towers, using relevant thermodynamic relations.

CO4 Illustrate the working, layout, and components of diesel, hydroelectric, and nuclear power plants, and evaluate their advantages and limitations.
CO5 Compare different power generation systems in terms of operating principles, applications, environmental impact, and efficiency.

Essential Reading

1. P.K Nag, Power Plant Engineering, McGraw Hill, 5th Edition, 2021
2. S.C Arora, A V Domkundwar, Power Plant Engineering, Dhanpat Rai Publication, 6/E 2024

Supplementary Reading

1. Dipak Kumar Mandal, Somnath Chakrabarti, Arup Kumar Das, Prasanta Kumar Das, Power Plant Engineering: Theory and Practice, Wiley, 1st Edition 2019
2. R. Yadav, Rajay, Sanjay, Fundamentals of Power Plant Engineering, IK International Pvt. Ltd, 2nd Edition 2022