HYBRID POWER PLANT ENGINEERING
(Professional Elective I)

I Semester

Course Code: 19ME2251

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Prerequisites: Engineering Thermodynamics and Thermal Engineering

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

CO1: Analyze advanced steam and gas turbine cycles.
CO2: Discuss binary and advanced power cycles.
CO3: Explain advances in nuclear and MHD power plants.
CO4: Explain how to combine different power plants and pollution caused by power plants.
CO5: Design for different loads and explain economic analysis of power plant.

UNIT-I: **(10-Lectures)**

Rankine Cycle – performance – thermodynamic analysis of cycles, cycle improvements, superheaters, reheaters – condenser and feed water heaters – operation and performance – layouts.
Gas turbine cycles – optimization – thermodynamic analysis of cycles – cycle improvements – multi spool arrangement. intercoolers, reheaters, regenerators – operation and performance – layouts.

Learning Outcomes: At the end of this unit, the student will be able to

1. Summarize various methods to improve efficiency of Rankine and Gas turbine cycles. (L2)
2. Examine the performance of a Rankine cycle based engine by applying thermodynamic principles through an analysis. (L4)
3. Design a gas turbine cycle though a thermodynamic analysis done on it. (L6)

UNIT-II: **(10-Lectures)**

Binary and combined cycle – coupled cycles – comparative analysis of combined heat and power cycles – IGCC – AFBC/PFBC cycles – thermionic steam power plant.

Learning Outcomes: At the end of this unit, the student will be able to

1. Demonstrate the working of binary and combined cycles. (L2)
2. Illustrate basic principle of working of a thermionic steam power plant. (L2)
3. Compare the thermal performance of combined heat and power cycles. (L4)

UNIT-III: **(10-Lectures)**

Overview of Nuclear power plants – radioactivity – fission process – reaction rates –diffusion theory, elastic scattering and slowing down – criticality calculations – critical heat flux – power reactors – nuclear safety. MHD and MHD – steam power plants.

Learning Outcomes: At the end of this unit, the student will be able to

1. Define various terms encountered with nuclear fission reaction. (L1)
2. Explain the working of different nuclear power reactors. (L2)
3. List merits and demerits of MHD power generation compared to steam power generation. (L4)

UNIT-IV: (10-Lectures)

Advantages of combined working – load division between power stations – storage type hydro-electric plant in combination with steam plant – run of river plant in combination with steam plant – pump storage plant in combination with steam or nuclear power plant – coordination of hydro-electric and gas turbine stations – coordination of hydro-electric and nuclear power station – coordination of different types of power plants. Air and water pollution –acid rains – thermal pollution – radioactive pollution – standardization – methods of control.

Learning Outcomes: At the end of this unit, the student will be able to

1. Summarize the coordination of different types of power plants. (L2)
2. List various methods to control air and water pollution. (L4)
3. Justify the merits of combined cycle power plants compared with conventional power plants. (L5)

UNIT-V: (10-Lectures)

Load curves–effects of variable load on power plant design and operation–peak load plant– requirements of peak load plants–cost of electrical energy–selection of type of generation– selection of generating equipment–performance and operating characteristics of power plants.

Learning Outcomes: At the end of this unit, the student will be able to

1. Identify the requirements of peak load power plants. (L3)
2. Select an optimum generation method and equipment for a proposed power plant. (L3)
3. Discuss performance and operating characteristics of power plants. (L6)

TEXT BOOKS:

1. P.K. Nag, *Power Plant Engineering*, Fourth Edition, Tata McGraw Hill Education Pvt. Ltd., NewDelhi, 2014.
2. Arora and Domkundwar, *A course in power Plant Engineering*, Sixth Edition, Dhanpat Rai and CO, 2013.

REFERENCE BOOKS:

1. R.W. Haywood, *Analysis of Engineering Cycles*, Fourth Edition, Pergamon Press, Oxford, 2012.
2. Allen J. Wood, Bruce F. Wollenberg and Gerald B. Sheblé, *Power Generation, Operation and Control*, Third Edition, Wiley, NewYork, 2013.
3. A.B. Gill, *Power Plant Performance*, Kindle Edition, Butterworth-Heinemann, 2016.
4. J.R. Lamarsh, *Introduction to Nuclear Engineering*, Third edition, Pearson, 2001.