GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Diploma Engineering
Level: Diploma
Branch: Mechanical Engineering
Subject Code: DI05019041
Subject Name: Power Plant Engineering

w. e. f. Academic Year:	2026-27
Semester:	5th
Category of the Course:	PEC-04

Prerequisite:	1. **Elements of Mechanical Engineering (DI01000191):** Familiarity with IC engines, turbines, boilers, compressors and basic mechanical systems. 2. **Engineering Thermodynamics (DI03019011):** Understanding of basic laws of thermodynamics, thermodynamic cycles (Carnot, Rankine, Brayton, Diesel), properties of steam and energy conversion principles. 3. **Fluid Mechanics (DI03000171):** Knowledge of fluid properties, fluid statics & dynamics and basic hydraulic machines. 4. **Engineering Mathematics (DI01000021):** Basic knowledge of differential equations, algebra and numerical methods used in engineering analysis.
Rationale:	Power Plant Engineering is an essential subject that provides students with fundamental knowledge of various power generation systems and their operation, including coal-based thermal, diesel, cogeneration, nuclear, and hydroelectric power plants. It enables understanding of energy conversion processes, plant components and performance analysis while emphasizing efficiency, reliability and environmental considerations. With growing energy demands and the need for sustainable development, this subject equips students with the skills required to analyze, design, operate and optimize power plants, thereby preparing them for careers in the power and energy sector as well as advanced studies in thermal and energy engineering.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes
01	Explain power generation fundamentals and evaluate economic factors such as load curve, tariff and cost of power in power plants.
02	Describe the layout, working principles and performance of modern coal-based thermal power plants and analyze their key components.
03	Interpret Hydroelectric power plant systems, including site selection, component identification and classification.

04	Explain Nuclear power plant operations, its types and waste disposal methods.
05	Identify elements and functions of Diesel and Gas Turbine power plants, including cogeneration and combined cycle systems.

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	Cr	ESE(E)	PA(M)	PA(I)	ESE (V)	
3	0	2	4	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	**Introduction to Power Generation and Economics** 1.1 Indian Energy Scenario 1.2 Energy Conversion in various power plants 1.3 Classification of Power Generating Stations 1.4 Power Plant Load and Performance Parameters ▪ Maximum Demand (Peak Load) ▪ Base Demand (Base Load) ▪ Load Curve ▪ Load Duration Curve ▪ Average Load ▪ Load Factor ▪ Plant Utilization Factor ▪ Diversity Factor 1.5 Economics of Power Generation ▪ Cost Analysis of Electrical Power ▪ Capital/Fixed Cost ▪ Operating and Maintenance Cost ▪ Financial Parameters 1.6 Various Tariff Methods 1.7Energy Sector:- Generation, Transmission and Distribution ▪ National Grid and Its Significance 1.8 Simple Numerical	10	22

	▪ Based on Load, Cost and Tariff		
2.	**Modern Coal-Based Thermal Power Generation** 2.1 Rankine Cycle:- Ideal & Actual Cycle 2.2 Methods for Improving Thermal Efficiency ▪ Superheating ▪ Reheating ▪ Regenerative Feed Heating 2.3 Configuration of Modern Thermal Power Plant ▪ General Layout and Working 2.4 Plant Auxiliary Systems and Circuits ▪ Fuel and Ash Handling System ▪ Air Supply and Flue Gas System ▪ Feedwater and Steam Circuit ▪ Condenser and Cooling Water System ▪ Lubrication System of Steam Turbine 2.5 High-Pressure Boilers ▪ Lamont Boiler ▪ Benson Boiler ▪ Modern Super critical Boilers ▪ Compare Super-critical with Sub-critical Boiler. 2.6 Combustion System ▪ Furnaces ▪ Pulverized Fuel Firing System 2.7 Emission Control System ▪ Electrostatic Precipitator (ESP) 2.8Turbine Control Mechanism ▪ Governing of Steam Turbine 2.9 Simple Numerical ▪ Based on Rankine Cycle and Efficiency	**15**	**33**
3.	**Hydroelectric Power Plant** 3.1 Fundamentals of Hydropower ▪ Classification ▪ Various purposes of Hydroelectric Power Plant 3.2 Configuration of Hydroelectric Power Plants ▪ General Layout and Working 3.3 Various Hydropower Plants ▪ Pump Storage Hydroelectric Power Plant ▪ Micro Hydel Power Plant 3.4 Site Selection of Hydroelectric Power Plant	**4**	**9**

4.	**Nuclear Power Generation Systems** 4.1 Fundamentals of Nuclear Science ▪ Nuclear Fission and Fusion ▪ Chain Reaction Mechanism ▪ Nuclear Fuels and Their Characteristics 4.2 Nuclear Reactor Systems ▪ Major Components of a Nuclear Reactor 4.3 Types of Nuclear Reactors: Construction and Operation ▪ Pressurized Water Reactor (PWR) ▪ Boiling Water Reactor (BWR) ▪ CANDU Reactor ▪ Fast Breeder Reactor (FBR) 4.4 Nuclear Waste Management ▪ Radioactive Waste and Disposal Methods 4.5 Site Selection Criteria for Nuclear Power Plants 4.6 Nuclear Power Development in India	**8**	**18**
5.	**Diesel, Gas Turbine and Cogeneration Power Plants** 5.1Diesel Engine Power Plant Fundamentals ▪ Applications of Diesel Power Plants ▪ Advantages and Limitations 5.2 Configuration of Diesel Power Plant ▪ Layout and Working Principle 5.3 Systems of Diesel Power Plant ▪ Fuel Supply System ▪ Air Intake and Exhaust System ▪ Cooling System ▪ Lubrication System ▪ Starting System 5.4 Gas Turbine Power Plants ▪ Auxiliary Systems of Gas Turbine Plant 5.5 Comparative Analysis ▪ Diesel Engine Vs Gas Turbine Power Plants 5.6Combined Cycle and Cogeneration Systems ▪ Cogeneration ▪ Combined Cycle Power Plant 5.7 Simple Numerical on Brayton Cycle	**8**	**18**
	Total	**45**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
23	**26**	**21**	**-**	**-**	**-**

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

Sr.No.	Title Of Book	Author	Publication
1.	Power Plant Engineering	P K Nag	Tata Mc Graw Hill
2.	Power Plant Engineering	Dr. P. C. Sharma	S. K. Kataria & Sons
3.	Power Plant Engineering	R. K. Rajput	Laxmi Publications
4.	Power Plant Engineering	Domkundwar	Dhanpat Rai & Co. Limited
5.	Power Plant Engineering	Black & Veatch	Springer Publication
6.	Power Station Engineering and Economy	Bernhardt G A Sarotzki, William A Vopat	Tata Mc Graw Hill

(b) Open source software and website:

1. http://nptel.ac.in/courses/112105051/
2. https://www.nrc.gov/reactors.html
3. https://www.energy.gov/eere/water/types-hydropower-plants
4. https://www.ntpc.co.in/
5. https://powermin.gov.in/
6. www.youtube.com/watch?v=kbuLfXgw4Gs
7. https://www.youtube.com/watch?v=r9q80sSHxKM
8. https://www.youtube.com/watch?v=IdPTuwKEfmA

Suggested Course Practical List:

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx .Hrs. Required

01	Demonstrate various energy conversion systems in different types of power plants.	**1**	**04**
02	Calculate the cost of power for given data of power station.	**1**	**02**
03	Calculate the Tariff of electric energy for (i) Domestic (urban) usage, (ii) Tariff for electric energy, (iii) Industrial usages and (iv) Agriculture usage from given data.	**1**	**04**
04	Demonstrate various circuits of modern coal-based Thermal power plants.	**2**	**04**
05	Demonstrate various high-pressure boilers.	**2**	**04**
06	Calculate Rankine cycle efficiency and specific steam consumption based on given data.	**2**	**04**
07	Demonstrate major components of Hydroelectric power plant.	**3**	**02**
08	Demonstrate major components of different Nuclear power plants.	**4**	**02**
09	Calculate Brayton cycle efficiency based on given data.	**5**	**02**
10	Demonstrate major components of the Diesel power plant.	**5**	**02**
Total (Hours)			**30**

List of Laboratory/Learning Resources Required:

Sr. No.	Equipment Name	Unit No.
1.	Model of coal-based thermal power plant (including all circuits).	**2**
2.	Models of high-pressure boilers: Lamont boiler Benson boiler	**2**
3.	Models of boiler furnaces.	**2**
4.	Model of hydroelectric power plant.	**3**
5.	Model of nuclear power plant.	**4**
6.	Models of nuclear reactors: Pressurized water reactor Boiling water reactor CANDU reactor	**4**
7.	Model of Diesel power plant.	**5**

8.	Model of gas turbine power plant.	**5**
9.	Model of cogeneration and combined cycle power plant.	**5**

Suggested Project List: (Group of 10 students)

1. **Energy Audit and Load Analysis**
Title: Electrical Load Survey and Energy Audit of Campus/Residential Area
Activities:
- Data collection
- Load curve and load factor calculation
- Tariff analysis

2. **Comparative Study of Power Plants in India**
Title: Technical and Economic Comparison of Thermal, Hydro, Nuclear and Gas Power Plants
Activities:
- Data collection
- Efficiency, cost, environmental impact comparison

3. **Emission Control in Thermal Power Plants**
Title: Study and Model of Electrostatic Precipitator (ESP)
Activities:
- Working principle study
- Model fabrication
- Efficiency analysis

4. **Nuclear Power Plant Safety Analysis**
Title: Study of Nuclear Reactor Safety Systems and Waste Management
Activities:
- Reactor types study (PWR, BWR, CANDU)
- Safety measures and disposal methods

5. **Smart Power Generation Concept**
Title: Integration of Conventional Power Plants with Smart Grid Concept
Activities:
- Study of national grid
- Load management techniques
- Future energy trends

Suggested Activities for Students:

Sr. No.	Activity
1.	Prepare load curve and load duration curve using real residential data for different season time.
2.	Case study on energy scenario in India
3.	Collect data for tariff for different types of consumer and explain it.
4.	Collect data of new installed power plants (type, capacity, place etc) in last 10 years.
5.	Explain possible impact on economy for different types of power plant.
6.	Explain various circuits of thermal power plant from given layout of power plant.
7.	Enlist coal-based thermal power plant specifications which is available nearby.
8.	Prepare a comparative analysis of high pressure boilers, super critical and sub critical boilers.
9.	Prepare property table for different types of fuel/energy which is useful for power generation.
10.	Explain scope of micro hydro power plant in your state.
11.	Case study of major Indian hydro projects such as Sardar Sarovar Dam
12.	Visit any coal-based/ Diesel engine/gas turbine/nuclear power plant.
13.	Collect data of diesel generating sets installed at nearby place.
14.	Prepare a presentation on various control systems for modern power plant.

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