



# GUJARAT TECHNOLOGICAL UNIVERSITY

**Program Name: Engineering**

**Level: Diploma**

**Branch: Electrical Engineering**

**Subject Code: DI03009021**

**Subject Name: Electrical Power Generation**

w. e. f. Academic Year:	2024-25
Semester:	3 <sup>rd</sup>
Category of the Course:	PCC

<b>Prerequisite:</b>	Fundamental knowledge of Electrical Engineering and Renewable energy sources.
<b>Rationale:</b>	Understanding the various technologies for power generation is vital, as each method has its own advantages, challenges, and suitability for different geographic or economic contexts. The curriculum includes a deep dive into conventional and renewable energy sources. This course therefore deals in detail about generation of electric power using Thermal (Coal), Hydro, Nuclear, Solar, Wind, Diesel and Other renewal energy sources and effect of variable load on power generation. These types of power plants need highly skilled technicians who are capable of operating various control equipment to supply uninterrupted electrical power. This course attempts to develop the basic cognitive skills required to take appropriate decisions to maintain the various generating and auxiliary equipment of power plants. Moreover, the safety precautions required to be followed by the diploma holders in various power plants is also included in this course.

## Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
1	Identify and explain the purpose and operation of major components of thermal power plants.	U
2	Identify and explain the purpose and operation of major components of hydro and nuclear power plants.	U
3	Demonstrate the fundamental principles of solar and wind energy along with their significance as renewable energy sources.	U
4	Describe the layout and working principles of different types of captive power plants	U
5	Solve problems related to load curve and load duration curve.	A

*\*Revised Bloom's Taxonomy (RBT)*



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## Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
L	T	PR	C	Theory		Tutorial / Practical		
				ESE (E)	PA(M)	PA(I)	ESE (V)	
3	0	0	3	70	30	0	0	100

## Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	<b>Thermal Power Plant</b> Contents: (1) Energy conversion process in thermal power station (2) Schematic diagram of thermal power station (3) Main flow circuits: Fuel and Ash circuit, Air and Gas circuit, Feed water and Steam circuit, Cooling water circuit (4) Efficiency of thermal power station: Thermal efficiency and overall efficiency (5) Advantages and disadvantages of thermal power station (6) List of thermal power stations in Gujarat with their capacity	12	26 %
2.	<b>Hydro-electric and Nuclear Power Plant</b> <b>Hydro-electric power plant:</b> Contents: (1) Energy conversion process in hydro-electric power station (2) Classification of hydro-electric power station (3) Constituents of hydro-electric power station: Hydraulic structure, Water Turbines, Electrical equipment (4) Different schemes of hydro-electric power station: High head, medium head, low head (5) List of major hydro-electric power station in Gujarat with their capacity <b>Nuclear Power Plant</b> Contents: (1) Energy conversion process for Nuclear power station (NPS) (2) Nuclear fusion and fission, Chain reaction	12	26%



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	(3) Main elements of nuclear reactor (4) Types of nuclear reactor (5) Schematic diagram of nuclear power station (6) Nuclear waste and its disposals (7) Advantages and disadvantages nuclear power station (8) List of nuclear power station in Gujarat and India with their capacity		
3.	<b>Power Generation through Solar and Wind</b> <b>Solar Energy</b> Contents: (1) Solar Photovoltaic (PV) power plant: components layout, construction, working. (2) Rooftop solar PV power system: Grid connected and Standalone <b>Wind Energy:</b> Contents: (1) Energy conversion in wind power plant (2) Advantages and limitations of wind power plant (3) Principles of rotation of wind turbine rotor (4) Important terms regarding wind power generation: Wind turbine efficiency, swept area, cut in wind speed, rated wind speed, cut out wind speed (5) Wind turbine types (HAWT and VAWT) and their construction (6) Layout of Horizontal axis large wind power plant: Geared wind power plant, Direct-drive wind power plant (7) Schemes of electric generation: Constant speed constant frequency, Variable speed constant frequency, variable speed variable frequency (8) List of major wind farms in Gujarat with their capacity	10	22%
4.	<b>Captive Power Plants</b> (1) Electrical energy conversion of DG sets, advantages and limitations (2) Layout of a Bio-chemical based (e.g. biogas) power plant, Layout of a Thermo-chemical based (e.g. Municipal waste) power plant, Layout of an Agro-chemical based (e.g. bio-diesel) power plant, Features of the solid, liquid and gas biomasses as fuel for biomass	6	13%



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	power plant. (3) Fuel Cell: Principle of electricity generation, Types, Advantages, Disadvantages		
5.	<b>Variable Load on Power Station</b> Contents: (1) Variable load on power station: effect of variable load (2) Types of Loads (3) Load curve and Load duration curve (4) Important terms and factor: Average demand, Maximum demand, Load factor, connected load, demand factor, diversity factor, coincidence factor, loss factor, plant capacity factor, plant use factor, utilization factor etc. (5) Base load and peak load power plants (6) Numerical based on above topics	5	13%
	<b>Total</b>	<b>45</b>	<b>100</b>

## Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	U Level	A Level	N Level	E Level	C Level
35 %	50 %	15%	-	-	-

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:

1. A Course in electrical power by J.B. Gupta, S.K. Kataria & Sons, New Delhi, 2013, ISBN 9789350143742
2. Electrical Power Systems by Dr. S.L.Uppal, Prof. S.Rao, Khanna Publisher, ISBN 978-8174092380
3. Generation of Electrical Energy, 7th Edition by B.R.Gupta, S. Chand Publishing, 2017, ISBN 9789352533817
4. Principles of Power System by V.K.Mehta, Rohit Mehta, S. Chand Publishing, ISBN 9788121924962



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5. Wind Power Technology by Earnest, Joshua, Third Edition, PHI Learning Pvt. Ltd., 2019, ISBN 9789388028509
6. Renewable Energy Technologies by Chetan singh Solanki, PHI Learning Pvt. Ltd., 2005, ISBN 9788120334342
7. Solar Photovoltaic by Chetan singh Solanki, Third Edition, PHI Learning Pvt. Ltd., 2015, ISBN 9788120351110
8. Fuel Cell Fundamentals By Ryan O'Hayre, Suk-Won Cha, Whitney Colella, Fritz B. Prinz, Wiley publication, 2016, ISBN 9781119113805

**(b) Open-source software and website:**

1. <https://nptel.ac.in/courses/108102047>
2. <https://www.electrical4u.com/electrical-engineering-articles/generation/>
3. <https://lectures.gtu.ac.in/> (related to course content)
4. <https://nptel.ac.in/courses/103103206>
5. <https://mnre.gov.in/>
6. <https://www.alternative-energy-tutorials.com/>

**Suggested Projects List:**

1. Build model to demonstrate layout of Thermal Power Plant.
2. Build working model to demonstrate working of Hydro Power Plant.
3. Prepare charts to demonstrate various cycles associated with Thermal Power Plant.
4. Prepare charts to demonstrate various schemes associated with Hydro Power Plant.
5. Prepare chart to demonstrate schematic diagram of Nuclear Power Plant.
6. Prepare chart of single line diagram of Electrical power system.
7. Build model to demonstrate concentrated solar power plant (CSP) / solar photovoltaic power plant
8. Build model to demonstrate power generation through wind energy.
9. Prepare chart to explain power generation through renewable energy sources.

**Suggested Activities for Students:**

Beyond classroom and laboratory learning, the following co-curricular activities are recommended to enhance the achievement levels of various outcomes in this course. Students are encouraged to undertake these activities either individually or in groups and prepare comprehensive reports of approximately five pages for each activity. Additionally, students should collect/record physical evidences for their portfolios, which could be beneficial during placement interviews:

- a) Prepare illustrative chart for various power plants.



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- b) Prepare working model of equipment used in power plants.
- c) Collect real time data of electric power generation through Thermal, Hydro and nuclear power plant in Gujarat state.
- d) Collect data of electric power generation through Solar, wind and other renewable energy sources in Gujarat state
- e) Prepare technical report on problems raised due to variable load on power stations.

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