GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

Course Curriculum

ELECTRIC POWER GENERATION
(Code: 3330904)

Diploma Programme in which this course is offered	Semester in which offered
Electrical Engineering	3rd semester

1. RATIONALE

Generation of Electric Power is most important activity in power system. With growing demand for electric power at one hand and depleting fossil fuel resources it has become more necessary to generate electric power more efficiently and with the help of renewal energy resources. With advancement in technology it has become possible to generate electric power commercially using wind and solar energy. This course therefore deals in detail about generation of electric power using Thermal (Coal), Hydro, Nuclear, Solar, Wind, Diesel and Other renewal energy sources. These types of power plants need highly skilled technicians who are capable of operating various control equipment to supply uninterrupted 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 engineering diploma holders in various power plants is also included in this course.

2. COMPETENCY ('Programme Outcome' according to NBA Terminology)

The course content should be taught and implemented with the aim to develop different types of skills so that students are able to acquire following competency.

- **Supervise the functioning of different types of electric power generating plants for safe operation.**

3. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	ESE	PA	ESE	PA	
04	02	00	06	70	30	00	00	100

Legends: L - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** - Practical; **C** - Credit; **ESE** - End Semester Examination; **PA** - Progressive Assessment

4. COURSE DETAILS

Unit	Major Learning Outcomes ('Course Outcomes' in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
Unit – I Thermal Power Station	1a. Explain thermal energy conversion process with block diagrams 1b. Identify the appropriate site of a TPS	1.1 Energy conversion process for thermal power station with plant layout 1.2 Selection criteria for site of thermal power station
	1c. Describe the working of thermal power station (TPS) Using single line diagram 1d. State the functions of the major equipment and auxiliaries of a TPS 1e. Distinguish between load curve and load duration curve 1f. Differentiate between base load and peak load power plants	1.3 Line diagram of thermal power station (TPS); Different cycles of TPS 1.4 Major equipment and auxiliaries of TPS (including Boiler, steam turbine, Turbo Generator, super heater, economizer and electro static precipitator) 1.5 Load curve and load duration curve 1.6 Base load and peak load power plants
	1g. State the critical safe practices to be complied with 1h. Name the major TPS in Gujarat	1.7 Safe Practices of TPS 1.8 Pollution generated by thermal power stations and methods to reduce them. 1.9 Principle of chimney and concept of draught. 1.10 Major TPS in Gujarat
Unit – II Hydro Power Station	2a. Explain hydro energy conversion process with block diagrams 2b. Identify the appropriate site 2c. Classify the different types of HPS 2d. Differentiate between different types of Hydro Turbines.	2.1 Energy conversion process for hydro-power station (HPS) with plant layout 2.2 Selection of site for HPS site 2.3 Major features of HPS 2.4 Classification of HPS: based on head, Storage and pondage, Plant Layout, types of hydro turbines; Auxiliaries
	2e. State the critical safe practices to be complied with 2f. Name the major HPS in Gujarat	2.5 Safe Practices of HPS 2.6 Difference between Generators for Thermal Plant and Hydro Plants. 2.7 Advantages of Hydro Power Plants and their effect on ecology/environment 2.8 Hydro power stations in Gujarat
Unit – III Nuclear Power Station	3a. Explain energy conversion process with block diagrams 3b. Identify the appropriate site for a NPS.	3.1 Energy conversion process for NPS: Nuclear fusion and fission, Chain reaction 3.2 Selection of site for NPS
	3c. Explain the working of Nuclear power station 3d. Describe various types of reactors	3.3 Working of nuclear power station 3.4 Various types of reactors
	3e. State special precautions required for NPS 3f. Name the major TPS in Gujarat	3.5 Special precautions for NPS 3.6 Advantages and disadvantage of NPS 3.7 Nuclear power stations in Gujarat
Unit – IV Solar Power Plant	4a. Explain the various solar energy parameters required for electrical power generation and their	4.1 Solar constants, Measurement of solar radiations 4.2 Large (more than 1 MW) Solar

Unit	Major Learning Outcomes ('Course Outcomes' in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
	measurement 4b. Name the large solar power plants in Gujarat	photovoltaic (PV) and concentrated solar power (CSP) solar plants in Gujarat
	4c. Describe the working of Solar concentrated power (CSP) systems	4.3 Solar Energy Conversion of CSP 4.4 CSP generators, construction and working principle
	4d. Explain principle of solar photovoltaic (PV)systems 4e. Solve simple numerical related to solar PV 4f. Discriminate between different types of solar PV systems.	4.5 construction of a solar PV systems: Solar cell, Module, Panel and array 4.6 Types of solar PV system: Stand – Alone,, Grid-Tied, Hybrid system
	4g. State the major safe practices for a solar PV power plant	4.6 Safety precautions of Solar PV systems
Unit – V Wind Power Plant	5a. Describe the power curve of wind turbines with single line sketches, 5b. Solve simple numericals related to the power in the wind 5c. Name the large wind farms in Gujarat 5d. State the major safe practices in the maintenance of large WPPs and small wind turbines	5.1 Anemometer, wind vane, site selection, Power of the wind, power curve of wind turbines 5.2 Large wind farms in Gujarat 5.3 Safety precautions to be during the routine maintenance of large and small wind turbines
	5e. Differentiate Horizontal Axis Wind Turbine(HAWT) and Vertical Axis Wind Turbine (VAWT) 5f. Distinguish between downwind and upwind wind turbines 5g. Differentiate the construction of a geared, direct drive and hybrid (semi-geared large wind power plants (WPPs)	5.4 HAWT and VAWT 5.5 Downwind and upwind wind turbines 5.6 Geared wind power plants (WPPs), direct-drive WPPs and Hybrid (semi-geared) WPPs
	5h. Differentiate the three types of aerodynamic control of WPPs Using the power curves.	5.7 Stall control, pitch control and active tall control of WPPs.
	5i. Evaluate the suitability of various types of electric generators adapted in large WPPs	5.8 Squirrel Cage Induction Generators (SCIG), wound rotor (WRIG), doubly-fed (DFIG), wound rotor synchronous generator (WRSG), Permanent magnet synchronous generator (PMSG)
	5j. Using single line sketches, label the major parts of direct-drive and geared small wind turbines 5k. Explain the drag and lift principle of rotation of wind turbines	5.9 Direct-drive and geared small wind turbines 5.10 Drag and lift principle of rotation of wind turbine rotors.
Unit – VI Captive power plant	6a. With single line diagram describe the electrical energy conversion process of DG sets	6.1 Electrical energy conversion of DG sets, advantages and limitations

Unit	Major Learning Outcomes ('Course Outcomes' in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
and other renewable energy sources	6b. With single line diagram describe the electrical energy conversion process of gas-based power plants	6.2 Electrical energy conversion of gas-based power plants, advantages, and limitations
	6c. With single line diagram describe the electrical energy conversion process of biomass energy	6.3 Electrical energy conversion of biomas energy, advantages and limitations
	6d. With single line diagram describe the electrical energy conversion process of ocean energy technologies	6.4 Electrical energy conversion of ocean technologies; tidal, wave, ocean current, ocean energy thermal conversion (OTEC), advantages and limitations
	6e. With single line diagram describe the electrical energy conversion process of geothermal energy	6.5 Electrical energy conversion of Geothermal energy, advantages and limitations

5. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Thermal Power Station	12	04	06	04	14
II	Hydro Power Station	10	03	05	04	12
III	Nuclear Power Station	06	03	03	02	08
IV	Solar Power Plant	10	03	05	04	12
V	Wind Power Plant	10	03	05	04	12
VI	Captive power plant and other renewable energy sources	08	05	04	03	12
Total		**56**	**21**	**28**	**21**	**70**

Legends: R = Remember; U = Understand; A = Apply and above levels (Bloom's revised taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

6. SUGGESTED LIST OF TUTORIAL EXERCISES

The practical/exercises should be properly designed and implemented with an attempt to develop different types of practical skills **(Course Outcomes in psychomotor domain)** so that students are able to acquire the competencies (Programme Outcomes). Following is the list of practical exercises for guidance.

Note: Here only Course Outcomes in psychomotor domain are listed as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of **Programme Outcomes/Course Outcomes in affective domain** as given in a common list at the beginning of curriculum document for this programme. Faculty should refer to that common list and should ensure that students also acquire those Programme Outcomes/Course Outcomes related to affective domain.

Sl. No.	Unit No.	Tutorial/Exercise (Course Outcomes in Psychomotor Domain according to NBA Terminology)	Approx. Hrs. Required
1	I to VI	Solve simple numerical related to different type of power generation plants	12
2	I	Interpret the line diagram of Thermal Power Station (T.P.S.) and main cycles & explain working of T. P. S.	02
3	I	Prepare technical report of visit to a nearby T.P.S./Prepare a report on thermal power stations in Gujarat by collecting data from Internet	04
4	I	Collect the data from nearest power station for load curve preparation and interpret it.	02
5	II	Prepare technical report of visit to a nearby H.P.S./Prepare a report on Hydro power stations in Gujarat by collecting data from Internet	04
6	III	Interpret the schematic diagram of Nuclear power station & explain the function of each component.	02
7	IV	Prepare technical report of visit to a nearby Solar PV station.	04
8	V	Prepare technical report of visit to a nearby Wind farm.	04
9	I	Visit the website of NTPC and prepare a report	02
10	II	Visit the website of NHPC and prepare a report	02
11	VI	Draw and Interpret schematic diagram of a Diesel Power Station	02
12	VI	Visit the website of MNRE/GEDA and prepare a report	02
13	VI	Visit a nearby Biogas plant and prepare a report	02
14	VI	Draw and Interpret schematic diagram of gas based power plant	02
		Total	**46**

7. SUGGESTED LIST OF STUDENT ACTIVITIES

i. Assignment on solving tutorial
ii. Visit to nearby Thermal power station
iii. Visit to nearby Hydro power station
iv. Visit to nearby Solar PV station
v. Visit to nearby Wind farm.
vi. Visit to nearby diesel power plant.
vii. Collect data of conventional generation for India and Gujarat
viii. Collect data of generating capacity of non- conventional power plants in India. (Total generation of India and Gujarat)

8. SPECIAL INSTRUCTIONAL STRATEGIES (if any)

i. Show video films or animation films on working of different type of power stations from YouTube and other resources.
ii. Visit to nearby power station
iii. Visit to wind power plants
iv. Visit to solar power plant
v. Visit to electrical substation.

9. SUGGESTED LEARNING RESOURCES

A) List of Books

S. No.	Title of Books	Author	Publication
1	Electrical Power system	Mehta, V.K.	S. Chand & Co., New Delhi, 2011
2	Wind Power Technology	Earnest, Joshua	PHI Learning, New Delhi, 2013
3	Electrical Power	Uppal, S.L.	Khanna publication, New Delhi, 2011
4	Power plant Engineering	Nag, P K	Tata McGraw Hill, New Delhi, 2011
5	Renewable Energy Technologies	Solanki, Chetan S.	PHI Learning, New Delhi, 2011
6	Generation and Utilization of Electrical Energy	S. Sivanagaraju	Pearson, New Delhi, 2011.
7	Solar PV Lab Manual	Solanki, Chetan S.	PHI Learning, New Delhi, 2013

B) List of Major Equipment/Materials with Broad Specifications

i. 5 kW Solar PV system
ii. 2 kW concentrated solar power (CSP) system
iii. 2 kW DG system
iv. 1 kW direct-drive small wind turbines
v. 5 kW geared small wind turbine
vi. Illustrative charts for TPS
vii. Illustrative charts for HPS
viii. Illustrative charts for NPS
ix. Illustrative charts for gas based plants

C) List of Software/Learning Websites

i. www.alternative-energy-tutorials.com
ii. http://www.mnre.gov.in/
iii. http://www.ntpc.co.in/index.php?option=com_content&view=article&id=64&Itemid=34&lang=en
iv. http://www.nhpcindia.com/hydro-technology.htm
v. http://www.npcil.nic.in/main/KnowledgePortal.aspx#
vi. http://www.powergridindia.com/_layouts/PowerGrid/User/ContentPage.aspx?PId=255&LangID=English
vii. http://www.youtube.com/user/EnergyShouldBe

10. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculty Members from Polytechnics

- **Prof. (Smt.) A. A. Amin,** Sr. Lecturer, Electrical Engineering Department, Govt. Polytechnic, Vadnagar. Gujarat
- **Prof. V. C. Jagani**, Sr. Lecturer, Electrical Engineering Department, Govt. Polytechnic, Junagadh, Gujarat
- **Prof. J.K.Rathod**, Head of Electrical Engineering Department, TFG Polytechnic, Adipur, Gujarat
- **Prof. K. V. Dave**, Sr. Lecturer, Electrical Engineering Department, Govt. Polytechnic, Rajkot, Gujarat

Faculty Members from NITTTR Bhopal

- **Dr. (Mrs.) C.S. Rajeshwari,** Professor & Head, Department of Electrical and Electronics Engineering
- **Prof. A.S. Walkey,** Associate Professor, Department of Electrical and Electronics Engineering