GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

Course Curriculum

GENERATION AND TRANSMISSION OF ELECTRIC POWER (Code: 3332402)

Diploma Programme in which this course is offered	Semester in which offered
Power Electronics	3rd semester

1. RATIONALE

Unlike the conventional power systems, the modern electric power systems also involves considerable amount of power electronics at different stages. Most of the renewable energy power plants such solar PV power plants and wind power plants invariable use power electronic devices and circuits. HVDC transmission system consists of power electronic components starting from generation to end user. This course will enable students to understand the basic components of power generation, transmission and distribution system. Such understanding will help to hone the skills to maintain power electronics components in the modern power system more thoughtfully.

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:

- **Maintain the power electronics for modern electric power systems.**

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	150
4	0	2	6	70	30	20	30	

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 Generation of Electrical Power	1a. Describe the structure of an electrical power system using single line diagram 1b. With block diagrams explain the working of different types of electric power plants 1c. State the role of GTOs, IGBTs in wind power plants 1d. Describe the role of signal conditioners in solar power plants	1.1 Single line diagram of electrical power system 1.2 Thermal, hydro, nuclear; wind and solar PV power plants: explanation with block diagrams, 1.3 Power electronic components used in wind, solar and bio energy power plants: GTOs, IGBTs, power electronic converters, signal conditioners
Unit – II HVAC and HVDC Transmission Systems	2a. Describe typical AC Transmission and Distribution system with line diagrams 2b. Differentiate the features and working of HVAC and HVDC systems 2c. State the power electronic components and circuits in a typical in a HVDC system with line diagrams	2.1. Typical AC Power supply system 2.2. HVAC and HVDC transmission systems: working, features, 2.3. Conductor material: overhead, underground cables 2.4. Power electronic components modern power systems: IGBTs, GTOs, STATCOMs
Unit – IV Performance of Transmission Lines	3a. Classify overhead transmission line.	3.1. Overhead transmission lines: short, medium and long.
	3b. Explain performance of short transmission line.	3.2. Performance of short transmission lines: single phase, three phase.
	3c. Differentiate between voltage regulation, transmission efficiency.	3.3. Voltage regulation, transmission efficiency.
Unit – II Variable Load on Power Stations	4a. Justify the need of interconnected electrical power system. 4b. Justify the importance of the load curve. 4c. Describe effects of variable load on power system 4d. Define the different terms related to load curves. 4e. Describe the features of the load duration curve. 4f. Depending on the base load and peak load, state the criteria of selecting the different types of power plants	2.1. Interconnected electrical power system. 2.2. Terms related to load curve: Base load and peak load, connected load, maximum demand, demand factor, average load, load factor diversity factor capacity factor plant use factor, units generated per annum. 2.3. Load duration curve. 2.4. Load curves and selection criteria of generating units. 2.5. Variable load: importance and effects
Unit – V Voltage Control and Power Factor	5a. Explain the importance of voltage control equipment and their location with line diagrams 5b. Classify different voltage control methods	5.1. Voltage control: importance, location, methods.
	5c. Explain different types of voltage control equipment with neat	5.2. Tap changing transformer, auto transformer tap changing and

Unit	Major Learning Outcomes (Course Outcomes in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
	sketches.	induction regulator.
	5d. Explain causes and disadvantages of low power factor. 5e. For given condition, select the relevant power factor improving equipment explaining how it works.	5.3. Power factor, power triangle, Low power factor: disadvantages, causes. 5.4. Power factor improving equipment: static capacitor, synchronous condenser and phase advancer

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

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Generation of Electrical Power	14	6	11	0	17
II	HVAC and HVDC Transmission Systems	9	3	5	2	10
III	Performance of Transmission line	9	2	5	3	10
IV	Variable Load on Power Stations	9	2	4	6	12
V	Voltage Control and Power Factor	15	4	8	9	21
	Total	**56**	**17**	**33**	**20**	**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 EXERCISES/PRACTICAL

The practical/exercises should be properly designed and implemented with an attempt to develop different types of practical skills **(Course Outcomes in psychomotor and affective 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.

S. No.	Unit No.	Practical/Exercise (Course Outcomes in Psychomotor Domain according to NBA terminology)	Approx. Hrs. Required
1	I	Prepare technical report of visit to a nearby Thermal power station (If visit not possible, study a thermal power station by visiting NTPC website)	04
2	I	Prepare technical report of visit to a nearby Hydro power station (If visit not possible, study a hydro power station by visiting NHPC website)	04
3	I	Prepare technical report of visit to a nearby Solar PV station.	04

S. No.	Unit No.	Practical/Exercise (Course Outcomes in Psychomotor Domain according to NBA terminology)	Approx. Hrs. Required
4	I	Prepare technical report of visit to a nearby Wind farm.	04
5	I	Prepare a report on major power stations in Gujarat	02
6	I	Assemble/dismantle direct-drive small wind turbine	02
7	I	Assemble/dismantle geared small wind turbine	02
8	I	Collect the data from nearest power station for load curve preparation and interpret it.	02
9	II	Collect the required data for Power station and prepare load curve.	04
10	IV	Identify the Safety measures while working on generating station and transmission line.	02
11	IV	Identify the major transmission lines in Gujarat.	02
12	IV	Draw the layout of national grid with transmission capacity.	02
		Total	**34**

7. SUGGESTED LIST OF STUDENT ACTIVITIES

Following is the list of proposed student activities like:

i. Collect the data from nearest power station for load curve preparation and interpret it.
ii. Collect photographs from internet which is related to field application of various topics.
iii. Identify the basic elements of the electric power system – generation, transmission, local distribution, and consumer load – and describe the role played by each element.
iv. Group discussion/ prepare a chart of different power plant and distribution system.
v. Prepare model of hydro power plant.
vi. Solve problems on voltage regulation, load curve and power factor.

8. SPECIAL INSTRUCTIONAL STRATEGIES (If Any)

i. Arrange visits to nearby thermal, hydro, wind and solar power stations
ii. Arrange visits to nearby sub stations.
iii. Show video/animation films on working of different types of power stations
iv. Show video/animation films on issues of voltage regulations and other features of different type of transmission lines including HVDC lines.

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	Power plant Engineering	Nag, P K	Tata McGraw Hill, New Delhi, 2011
3	Wind Power Technology	Earnest, Joshua	PHI Learning, New Delhi, 2013
4	Electrical Power	Uppal, S.L.	Khanna publication, 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. Digital clamp-on meter – 0-30 A, 0-500V
ii. Power supply system demonstration unit
iii. High voltage tester - upto 11kV
iv. CT/PT
v. Power Factor meter
vi. Frequency meter

C) List of Software/Learning Websites

i. ETAP
ii. MI POWER
iii. http://www.downloadmela.com/video-watch?sno=225
iv. http://en.wikipedia.org/wiki/Electric_power_transmission
v. http://www.beatmap.net/portfolio-detail/nuclear-fossil-power-plant-3d-animations/
vi. http://www.powerworks.com.au/educationandresources/powerplant-animation

10. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculty Members from Polytechnics

- **Prof. K. J. Dhimar**, HOD, Dept. of Power Electronics, Dr. S. & S. S. Ghandhy College of Engg. and Technology, Surat
- **Prof. S. A. Patel**, LPE, Dept. of Power Electronics, Dr. S. & S. S. Ghandhy College of Engg. and Technology, Surat
- **Prof. S. L. Dhoriyani**, LPE, Dept. of Power Electronics, Dr. S. & S. S. Ghandhy College of Engg. and Technology, Surat
- **Prof (Smt.) J. M. Patel**, ALPE, Dept. of Power Electronics, Dr. S. & S. S. Ghandhy College of Engg. and Technology, Surat

Coordinator and Faculty Members from NITTTR Bhopal

- **N.P. Patidar,** Professor, Department of Electrical and Electronics Engineering.
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