



# GUJARAT TECHNOLOGICAL UNIVERSITY

**Bachelor of Engineering**  
**Subject Code: 3142404**

**Semester – IV**  
**Subject Name: Basic Power System Engineering**

**Type of course: Engineering Science (Power Electronics)**

**Prerequisite:** Fundamental of Electrical Engineering

**Rationale:** The Generation, Delivery and Efficient use of electric power and energy remain one of the most challenging and exciting fields of Power Electronics Engineering. The astounding technological developments of our age are highly dependent upon a safe, reliable, and economical supply of electric power because of varying characteristics of yesterdays versus tomorrow's utilities. The objective of the Basic Power System Engineering is to provide a contemporary overview of this far-reaching field as well as a Power System operation, performance, management and understanding of new trends and technology. This technology will help to learn about the equipment, control techniques and methods used in Flexible Alternating Current Transmission Systems (FACTS) and High Voltage Direct Transmission (HVDC) equipment to enable a single, coherent approach to address a specific power system problem, using 'best of breed' solutions bearing in mind technical, economic and environmental issues. The course will provide understanding of power generation technology using conventional and non conventional energy sources which will be useful for understanding the operation and working of power plants. Students will understand the operation, maintenance and working of substations.

## Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
4	1	0	5	70	30	0	0	100

## Content:

Sr. No.	Content	Total Hrs
1	Introduction : Basic Layout of Power System- Electric Power and Generating Stations : Electric Power System – Sources of Electrical Energy – Generation, Transmission and Distribution of Electric Power, Schematic Arrangement of Different Power Plants like Hydro, Thermal, Nuclear, Diesel, Solar, Wind, etc. – Other Renewable Sources of Energy – Gas Turbine Power Plant – Schematic Arrangement of Gas Turbine Power Plant – Comparisons of Various Power Plants	10
2	Transmission Line Fundamental and Parameters: Introduction of Transmission lines - Constants of Transmission Lines – Flux Linkage in Current Carrying Conductors – Inductance of a Single Phase Two Wire Line and Composite Conductor Lines – Inductance of Three Phase Lines With Symmetrical and Unsymmetrical	06



# GUJARAT TECHNOLOGICAL UNIVERSITY

**Bachelor of Engineering**

**Subject Code: 3142404**

	Spacing With and Without Transposition – Capacitance of a Single Phase and Three Phase Transmission Line- Bundled Conductors - Resistance in Transmission Lines – Skin Effect-concept of corona – Proximity Effect – Introduction to Double Circuit Three Phase Lines.	
<b>3</b>	Reactors and Insulator: Introduction to Reactors – Need and Types of Reactors – Location of Reactors –Selection of Power Reactors –Application of Reactor in Power System. Introduction to Insulators – Need and types of Insulators – Location of Insulator – Selection of Insulators- Consideration of Interface and corona – Tests on Insulator- characteristics of Insulator.	<b>04</b>
<b>4</b>	Sub-stations: Introduction – Classification of Sub-station – Types And Comparison of Sub-station – Symbols for Equipment in Sub-stations – Elements in a Transformer Sub-stations – Bus-bar Arrangements in Substation – Under Ground Sub Stations – Details of Indoor Substation.	<b>04</b>
<b>5</b>	Power Factor Improvement: Power Factor – Power Triangle – Disadvantages of Low Power Factor – Causes of Low Power Factor – Advantages of Power Factor Improvement – Methods of Improving Power Factor – Calculations of Power Factor Correction – Most Economical Power Factor	<b>06</b>
<b>6</b>	Power System performance, Operation , Management and New Trends and Technology: Introduction- Series and Shunt Compensation –Concept Power System Stability – Introduction to FACTS Controllers – Railway Electric Transmission and Distribution – Power Electronics Interface with Renewable Energy Sources. Concept of Grid- Types of Grid and its importance in Power System.	<b>04</b>
<b>7</b>	HVDC Transmission: Introduction – Converter Basics – Types of DC Links – Structure and Principles of HVDC Control – Converter Performance – Advantages and Disadvantages – Applications	<b>04</b>
<b>8</b>	AC and DC Transmission and Distribution System - Elements of Transmission and Distribution System - Concept of grounding and Earthing - Isolated Neutral – Requirement and Advantages of Neutral Grounding – Earth Neutral Systems: Solid, Resistance and Resonant Grounding (Earthing) – Arc Suppression Coil Grounding (Resonant Grounding) – Voltage Transformer Earthing – Grounding (Earthing) Transformer – Introduction and types of Cable.	<b>04</b>

### **Suggested Specification table with Marks (Theory): (For BE only)**

<b>Distribution of Theory Marks</b>					
R Level	U Level	A Level	N Level	E Level	C Level
12	23	20	5	5	5

**Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom’s 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.



# GUJARAT TECHNOLOGICAL UNIVERSITY

**Bachelor of Engineering**

**Subject Code: 3142404**

## Reference Books:

1. Principles of Power System, Fourth Edition by V. K. Mehta & Rohit Mehta,
2. Modern Power System Analysis, Fourth Edition by Kothari & Nagrath
3. Electrical Power Systems by C. L. Wadhwa
4. HVDC Power Transmission Systems by K. R. Padiyar.
5. A Text book of Power System Engineering, A Chakrabarti, M. L. Soni, P. V. Gupta, U. S. Bhatnagar
6. Utilization of Electric Power and Electric Traction by J.B. Gupta
7. Power System Analysis by J. B. Gupta.
8. Electrical Power, Dr. S.L. Uppal
9. Electric Power Generation: Transmission and Distribution, S. N. Singh.

## Course Outcomes:

Sr. No.	CO statement: After Learning the Course Student should be able to :	Co-topic Mapping	Marks % weightage
CO-1	select the appropriate type of power generating station following norms and guidelines related to cost, environment, societal and ethical issues.	1	25
CO-2	calculate various parameters for analysis of electrical design aspects of the transmission system.	2	25
CO-3	analyze different types of Power System components and distribution systems.	3-4-8	20
CO-4	Compare different types of substation components and its layout along with appropriate Power Factor Improvement technique.	4-5-7	15
CO-5	apply their knowledge in power system performance, operation, New Trends & Technology including HVDC transmission, micro and small structure of power system etc.	6-8	15

Web-based tools for design: -

<https://etap.com/>

<http://www.rpowerlabs.org/>

Circuit Lab: - <https://www.circuitlab.com/editor/>

Open source Math Tools: - <http://maxima.sourceforge.net/>

<http://www.sagemath.org/>

<http://www.scilab.org/>

<http://www.gnu.org/software/octave/>

Learning website:

<https://nptel.ac.in/courses/108105067/1>

<https://nptel.ac.in/courses/108102047/>



# GUJARAT TECHNOLOGICAL UNIVERSITY

**Bachelor of Engineering**  
**Subject Code: 3142404**

<https://nptel.ac.in/courses/108101040/download/lec-18a.pdf>

<https://nptel.ac.in/courses/108108078/1>

<https://docs.google.com/a/vgecg.ac.in/viewer?a=v&pid=sites&srcid=dmdlY2cuYW58cG93ZXJlbGVjdHJvbmljc3xneDo5N2UyYzhhMWNmODExODQ>