FACULTY OF ENGINEERING & TECHNOLOGY

Effective from Academic Batch: 2022-23

Programme: **Bachelor of Technology (Electrical Engineering)**

Semester: **IV**

Course Code: **202050403**

Course Title: **Power Systems-I**

Course Group: **Professional Core Course III**

Course Objectives: 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 learn the basics of Tariff structure for energy production. Students will understand the operation, maintenance and working of substations. While giving conceptual understanding of Electrical Power System, it also setup the background which facilitate the students to learn and understand higher level courses of the power system.

Teaching & Examination Scheme:

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
				Theory		J/V/P*		Total
Lecture	Tutorial	Practical		Internal	External	Internal	External	
4	0	2	5	50 / 18	50 / 17	25/9	25 / 9	150 / 53

* **J**: Jury; **V**: Viva; **P**: Practical

Detailed Syllabus:

Sr.	Contents	Hours
1	**Conventional Generation, Load Curves and Tariffs:** Generation scenario in India and Gujarat, Steam power station, Schematic arrangement of steam power station, Equipments of steam power station, Hydroelectric power station, Schematic arrangement of hydro-electric power station, Constituents of hydro-electric plants, Nuclear power station, Schematic arrangement of nuclear power station, Nuclear reactor, Gas turbine power plant, Schematic arrangement of gas turbine power plant, comparison of various power plants. Load curves, Important terms and factors, Load duration curve, Examples. Tariff, Desirable characteristics of tariff, Types of tariff, Examples..	08

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2	**Introduction to Wind and Solar Power Generation:** The wind power plant – Introduction, wind turbine classes, Wind Turbine Components (Rotor, Nacelle, Tower, Electric Substation, Foundations) Wind Energy Conversion – Rotation principle, Forces on a rotor blade, Factors affecting performance of rotor (Aerodynamic efficiency, tip speed, tip seep ratio etc.), Thrust and torque on rotor, Power curve. Topologies and operation characteristics of SCIG based wind turbine power plant. Working Principle and operation characteristic of WRIG based wind turbine power plant. Concentrated Solar Power (CSP) plant Operation and its working, Photovoltaic Conversion – Introduction, Description and principle of working, performance characteristics of a solar cell, types of solar cell, photovoltaic system applications, Stand-alone PV system configurations, Grid-connected PV systems.	**08**
3	**Electrical Supply Systems:** Electric supply system, Typical ac power supply scheme, Advantages of high transmission voltage, Overhead v/s underground systems, Requirements of a distribution system, Connection schemes of distribution system. AC Distribution – Methods of solving AC distribution problems, Four wires star connected unbalanced load,Examples..	**05**
4	**Power Factor and Power Factor Improvement of Load:** Power factor, Power factor triangle, Causes of low power factor, Disadvantages of low power factor, Power factor improvement, Power factor improvement equipment, Calculations of power factor correction, Most economical power factor, Examples.	**05**
5	**Mechanical Features and Design of Overhead Transmission Line:** Main components of overhead lines, Conductor materials, Line supports, Insulators, Types of insulators, String efficiency, Methods of improving string efficiency, Examples, Sag in overhead lines, Calculation of sag, Examples.	**08**
6	**Transmission Line Parameters:** Line resistance, Inductance of single conductor, Inductance of single phase lines, Flux linkages in terms of self and mutual inductances, Inductance of 3-phase transmission lines – Symmetrical spacing, asymmetrical spacing and transposed lines, Inductance of composite conductors, Inductance of 3-phase double circuit lines, Examples. Line capacitance, Capacitance of single phase lines, Capacitance of three phase lines, Effect of bundling, Capacitance of three phase double circuit lines, Effect of earth on the capacitance, Examples..	**14**
7	**Underground Cables:** Underground cables, construction of cables, Insulating materials of cables, Classification of cables, Cables for 3-phase service, Insulation resistance of a single core cable, Capacitance of a single core cable, Dielectric stress in single core cable, Most economical conductor size in cable, Grading of cables, Capacitance grading, Inter- sheath grading, Capacitance of 3-core cables, Measurement of core to core and core to earth capacitances, Examples.	**07**

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8	**Substations:** Classification of substations, Transformer substation, Pole mounted substation, Underground substation, Symbols for equipments in substations, Equipments in a transformer substation, Bus-bar arrangements in substations, Terminal and through substations, Key diagrams of 66/11 kV substation and 11/400 kV indoor substation.	**04**
9	**Neutral Grounding:** System with ungrounded neutral, Neutral grounding, Advantages of neutral grounding, Methods of neutral grounding – Solid grounding, Resistance grounding, Reactance grounding, Resonant grounding, Voltage transformer earthing, Grounding transformer.	**05**

List of Practicals / Tutorials:

1	Introduction to Power System Components.
2	To Study the Schematic Diagram of Thermal, Hydro and Nuclear Power Plant.
3	Study of Substation Layout and Equipments used in Substations.
4	Floating Star-Point in a Three Phase Distribution System.
5	Study of Load Curve Preparation and its Interpretation.
6	To Study Power Factor Improvement.
7	Voltage Distribution across the String of Suspension Insulator.
8	Computation of Transmission Line Parameters (Inductance And Capacitance) using Matlab Part-I.
9	Computation of Transmission Line Parameters (Inductance And Capacitance) using Matlab Part-II.
10	To Study Generation and Transmission Scenario in Gujarat and India.
11	Tutorial on Sag Calculations.
12	Tutorial on Distribution Systems.

Reference Books:

1	Principles of Power System: V. K. Mehta, Rohit Mehta, S. Chand Publications
2	Wind Power Technology: Earnest Joshua, PHI Learning Pvt. Ltd.
3	Solar Energy: S. P. Sukhatme, McGraw Hill Education India Pvt. Ltd.
4	Power System Analysis: HadiSaadat, McGraw Hill Education India Pvt. Ltd.
5	Electrical Power systems: C. L .Wadhwa, New Age International Publishers
6	Electrical Power Systems: Dr. S. L. Uppal, Prof. S. Rao, Khanna Publications
7	Power System Analysis : John J. Grainger, William D. Stevenson Jr., McGraw Hill Education
8	Modern Power system Analysis by I J Nagrath, D P Kothari, McGraw Hill Education

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Supplementary learning Material:	
1	https://swayam.gov.in
2	www.nptel.ac.in
3	http://vp-dei.vlabs.ac.in/Dreamweaver/list.html

Pedagogy:

- Direct classroom teaching
- Audio Visual presentations/demonstrations
- Assignments/Quiz
- Continuous assessment
- Interactive methods
- Seminar/Poster Presentation
- Industrial/ Field visits
- Course Projects

Internal Evaluation: The internal evaluation comprised of written exam (40% weightage) along with combination of various components such as Certification courses, Assignments, Mini Project, Simulation, Model making, Case study, Group activity, Seminar, Poster Presentation, Unit test, Quiz, Class Participation, Attendance, Achievements etc. where individual component weightage should not exceed 20%.

Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):

Distribution of Theory Marks in %						**R**: Remembering; **U**: Understanding; **A**: Applying; **N**: Analyzing; **E**: Evaluating; **C**: Creating
R	**U**	**A**	**N**	**E**	**C**	
40%	20%	20%	20%	0%	0%	

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.

Course Outcomes (CO):

Sr.	Course Outcome Statements	%weightage
CO-1	Compare various means of conventional electrical power generation and evaluate load curves, tariff structures and power factor and load power factor improvement.	**15**
CO-2	Power generation using solar and wind energy looking to current energy and environment scenario.	**10**
CO-3	Carry out mechanical design of overhead line.	**20**

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CO-4	Compute resistance, inductance and capacitance of overhead lines and underground cables and develop programs for design and performance parameters.	**25**
CO-5	Acquire knowledge about electrical supply system, substation equipment's & layout and methods of neutral grounding	**30**

Curriculum Revision:	
Version:	2.0
Drafted on (Month-Year):	June-2022
Last Reviewed on (Month-Year):	
Next Review on (Month-Year):	June-2025

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