GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: ELECTRICAL ENGINEERING

SUBJECT NAME: POWER SYSTEM PLANNING AND DESIGN

SUBJECT CODE: 2180903

B.E. 8th SEMESTER

Type of Course: Engineering

Prerequisite: Electrical power generation and Electrical power system-I

Rationale: This subject focuses on the mechanical and electrical design aspects of important power system components. In this subject students will learn basic concepts of generation,planning, transmission and distribution planning. The course also includes power system earthing and insulation co-ordination.

Teaching Scheme			Credits	Examination Marks						Total Marks
				Theory Marks			Practical Marks			
L	T	P	C	ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	0	2	5	70	20	10	20	10	20	150

Content:

Sr. No.	Content	Total Hrs	% Weight
1.	**Transmission lines design :** Requirements of transmission lines, selection of voltage for high-voltage transmission lines, choice of conductors, spacing of conductors, corona, insulators, specifications of transmission lines, surge-impedance loading of transmission lines, electrical design of transmission lines, main considerations in the mechanical design of transmission lines, sag-tension relation, stringing of transmission lines, towers Design of EHV transmission lines : transmission of electric power at extra-high voltage, design considerations of EHV lines, selection and spacing of conductors, corona, radio and television interference, insulation co-ordination, towers**[1]**	**10**	**20 %**
2.	**Design of distribution systems :** Development of a distribution plan, transmission and distribution systems, types of distribution systems arrangements, primary distribution design, secondary distribution design,	**8**	**20 %**

	distribution substations, calculation of distributor sizes: voltage drops, voltage regulation, Lamp flicker**[1]**		
3.	**Design of power system :** Introduction, selection of sizes and location of generating stations, selection and specifications of transmission lines, sizes and location of substations, interconnection**[1]**	**5**	**8 %**
4.	**Power System Earthing :**Objectives, definitions, tolerable limits of body currents, soil resistivity, earth resistance, tolerable step and, actual step and touch voltage, design of earthing grid, concrete encased electrodes, tower footing resistance, measurement of earth resistance R, measurement of soil resistivity, impulse behavior of earthing system.**[2]**	**5**	**15 %**
5.	**Insulation Co-ordination:** Introduction, definitions, determination of line insulation, B.I.L and insulation levels of sub-station equipment, lightning arrester selection, power system overvoltages, tentative selection of arrestor voltage ratings, selection of arrestor discharge currents, arrestor discharge voltage, establishment of impulse voltage level of equipment, protective margin, establishment of separation limits, location of lightening arrestor**[3]**	**5**	**15 %**
6.	**Power system improvement:** Introduction, methods of power system improvement, power system improvement scheme, determination of the voltage regulation and losses in a power system, shifting of distribution transformer centre, financial aspects of the power system improvement scheme**[1]**	**4**	**10 %**
7.	**Power system planning:**Introduction, methods of power system planning, forecasting load and energy requirements, generation planning, transmission system planning, distribution system planning, reliability of electrical power systems, methods of measuring power system reliability**[1]**	**5**	**12 %**

Note: It is suggested that based on the above syllabus, visits for LT/HT Electrification and 220KV/ 400 KV substations should be carried out.

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks (%)					
R Level	U Level	A Level	N Level	E Level	C Level
10	**25**	**30**	**20**	**10**	**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.

Reference Books:

1. Electrical Power System Design – M. V. Deshpande, TMH publication

2. Electrical Power System Design – B. R. Gupta, S. CHAND

3. A course in Electrical Power- Soni, Gupta and Bhatnagar, DhanpatRai& Sons

4. Substation Design – Satnam& Gupta, DhanpatRai andCo.

5. Electrical Power System Planning – A. S. Pabla, TMHpublication

Course Outcome:

After learning the course the students should be able to:

1. Design transmission line (electrical and mechanical aspects)
2. Design primary and secondary distribution.
3. Selection of sizes and location of generating stations, substations.
4. Explain the basic concepts of power system earthing and measurement of earthing resistance.
5. Explain the basic concepts of insulation co-ordination.
6. Explain the basic concepts of generation planning, transmission planning and distribution planning.

List of Experiments: (This is a suggestive list only)

During the laboratory hours, the design problems based on the syllabus should be assigned to the students.

1. Design of transmission line.
2. Visit of substation and draw its lay out plan.
3. Design of transmission line towers.
4. Survey of rural electrification and draw Single Line Diagram.
    - Visit to a village.
    - Supply is taken from pole mounted transformer and distributed in various part of village.
    - Load calculation, loading capacity of different equipments.
    - Verification of 3-phase balanced loading.
    - Finding transformer rating based on loading.
    - Making drawing sheet representing Single line diagram of three phase distribution.
5. Survey of industrial distribution system and draw Single Line Diagram SLD.
6. Study pipe earthing and plate earthing.
7. Students should learn Indian standards related to design problems.

    Following Indian standards are just suggestive list only.

    I. IS 282-1982 for Hard-drawn copper conductors for overhead power transmission (second revision)

    II. IS 398(Part 1):1996 for Aluminium conductors for overhead transmission purposes: Part 1 Aluminium stranded conductors (third revision)

    III. IS 398(Part 2):1996 for Aluminium conductors for overhead transmission purposes: Part 2 Aluminium conductors, galvanized steel reinforced (third revision)

    IV. IS 60071(Part 1):2006 for Insulation Coordination - Part 1 Definitions, principles and rules.

V. IS 3043:1987 for code of practice for earthing

VI. IS 12360:1988 for Voltage Bands For Electrical Installations Including Preferred Voltages And Frequency

VII. IS 15086(Part 5):2001 for Surge arresters: Part 5 Selection and application recommendations.

VIII. IS 3716:1978 for Application guide for insulation coordination (first revision).

IX. IS 60071(Part 1):2004 for Insulation coordination – Part 4: Computational guide to insulation co-ordination and modelling of electrical networks.

8. Survey of Cables/Conductors used in transmission and distribution system.

List of learning website

- https://law.resource.org/pub/in/bis/ (useful website to download Indian standards)
- http://www.electrical-engineering-portal.com/
- nptel.ac.in/course.php

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should be submitted to GTU.