GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: Electrical Engineering
SUBJECT NAME: Interconnected Power System
SUBJECT CODE: 2170901
B.E. 7th SEMESTER

Type of course: Engineering

Prerequisite: Electrical Power system I and Electrical Power Systems II

Rationale: This subject focuses on the study of behavior of power system components during normal operating conditions and/or when subjected to disturbances along with the basics of power system transmission and distribution. It also briefs the students about the modeling of power system components and networks for steady state analysis. They will be able to use the knowledge in economic operation and planning of power system network and also for the selection of components Like CB(Circuit Breaker for Power system protection.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	00	02	05	70	20	10	20	10	20	150

Content:

Sr. No.	Content	Total Hrs	% Weight
1	**Introduction:** Concept of Interconnection, Hierarchical Grid arrangements, Cascade Tripping, Islanding, Load dispatch centre, Power Generation Scenario in Gujarat and India	03	5
2	**Power system matrices** Brief explanation of Graph theory, Primitive Network, Ybus formation methods, Singular transformation method, Direct method, Removal of elements, Algorithm for formation of Zbus matrix addition of branch and link, Numericals [4]	08	15
3	**Load flow studies** Introduction, Static Load Flow Equations, Bus Classifications, Approximate method, Gauss-Seidel Method, Newton Raphson Method, Fast Decoupled Load Flow Method, Comparison of different methods, Numericals[1]	10	25
4	**Economic operation of power systems** Generator operating cost, Economic operation of generators within thermal plant, Optimal operation by co-ordination equation, Penalty factor, Derivation of transmission loss formula (Kron's method), Unit	06	15

	commitment problem solution by dynamic programming, Numericals[5]		
5	**Frequency and voltage control methods** Speed governing mechanism, Mathematical modeling, Adjustment of Governor characteristics, Single area control, Flat frequency control, Selective frequency control, Tie line load bias control, Methods of voltage control, Numericals[3]	06	10
6	**Power system stability** Introduction, Mechanics of angular motion, The swing Education, transfer reactance, power relations, Steady state stability, Synchronizing power coefficient, Analysis of steady state stability, steady state stability with automatic voltage regulators, concept of shunt fault, transfer reactance during fault, reduction of power system to one machine connected to infinite bus, Transient stability, simplified transient generator model, The equal area stability criterion, solution of swing equation, Numericals **[2]**	12	30

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	**20**	**25**	**25**	**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.

Reference Books:

1. **Modern Power System Analysis,** D. P. Kothari, I. J. Nagrath, Tata McGraw-Hill Education,
2. **Power System Analysis and Stability, S.S. Vadhera, Khanna Publication**
3. **Power System Analysis, Hadi Saadat,** Tata McGraw-Hill Education
4. **Computer Aided Power System Analysis, G.L. Kusic, © 1986**
5. **Elements of Power System Analysis by William D. Stevenson McGraw-Hill**

Course Outcome:

After learning the course the students should be able to:

Model modern power system network

Solve the problem of power flow through any power system network

Find economical generation of power and rescheduling of power

Solve swing equation

Find the stability of a power system

Find the variation in the frequency because of change in generation

List of Experiments/Tutorials (Suggested):

Formation of Primitive, incidence Ybus and Zbus matrix for given network

Derivation of static load flow equation for a sample 4 bus system

Solution of static load flow equation using approximate method of Load Flow

Solution of static load flow equation using Gauss-Seidel Method of Load Flow

Solution of static load flow equation using Newton Raphson Method of Load Flow

Solution of static load flow equation using Fast Decoupled Load Flow Method of Load Flow

Find most economical generation on generator of a given power system

Find the penalty factor for the given system

Find (Beta) cooficient for the given system

Find the steady state/transient stability of the system for various disturbances in power system

Find critical clearing time using equal area criterion

Solution of swing equation using step by step method

Working of SLDC/ALDC/RLDC

Design based Problems (DP)/Open Ended Problem:

The students can be asked to collect the data of a small power system network. Then the model of the same network should be prepared using the knowledge gain by studying this course. Various analyses like power flow analysis. Stability analysis, load frequency analysis and economic analysis can be performed on the same system.

Major Equipment:

Computers and programming software like C C++ or MATLAB SCILAB

List of Open Source Software/learning website:

NPTEL

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 submit to GTU.