FACULTY OF ENGINEERING & TECHNOLOGY

Effective from Academic Batch: 2022-23

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

Semester: **VII**

Course Code: **202050702**

Course Title: **Power System Analysis**

Course Group: **Professional Core Course -XVI**

Course Objectives: The demand for electrical power is increasing day by day. This requires modeling the transmission network accurately and calculating the power system parameters so that the transmission network can be operated efficiently and reliably. The subject briefs the students about the modeling of power systems networks for steady state analysis. They will also learn the economic operation and planning of the power system network and also use the knowledge for the selection of components like Circuit Breaker for Power system protection.

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	
3	0	2	4	50 / 18	50 / 17	25 / 09	25 / 09	150 /53

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

Detailed Syllabus:

Sr.	Contents	Hours
1	**Introduction:** Concept of Interconnection, Hierarchical Grid arrangements, Cascade Tripping, Islanding, Load dispatch center	03
2	**Power system matrices** Brief explanation of Graph theory, Primitive Network, Ybus formation methods: Singular transformation method, Direct method, effect of addition and deletion of shunt elements on Y_{bus}, Numerical	04

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3	**Load flow studies** Introduction, Bus Classifications, formation of Static Load Flow Equations (LFE), Approximate method of solution of LFE, Application of Numerical method for solution of nonlinear algebraic equations - Gauss-Seidel Method, Newton Raphson Method, Fast Decoupled Load Flow Method, Comparison of different methods of solution of load flow equations, Numerical	**12**
4	**Economic operation of power systems** Generator operating cost, Economic operation of generators within thermal plant, Optimal operation by coordination equation, Penalty factor, Derivation of transmission loss formula (Kron's method), Unit commitment problem solution by dynamic programming, Numerical, Power Exchanges, Spot Pricing. Electricity Market Models (Vertically Integrated, Purchasing Agency.	**08**
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, Numerical	**06**
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, Numerical	**12**

List of Practicals / Tutorials:

1	To study matrix algebra using MATLAB.
2	To form a bus incidence matrix using graph theory by MATLAB.
3	To formulate the Y_{bus} matrix by direct method.
4	To formulate Y_{bus} matrix by singular transformation method.
5	To study power flow in transmission systems by Power World Simulator.
6	Calculate transmission losses and voltage drop by Power World Simulator.
7	To study numerical techniques using MATLAB.
8	Load flow study by G-S method.
9	Load flow study by N-R method.
10	Load flow study by FDLF method.
11	To study equal area criterion using MATLAB.
12	To obtain unit commitment of a power plant.
13	To obtain economic load dispatch of power plant

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14	To determine stability of a small system using a numerical method.
15	To obtain economic load dispatch of generators considering transmission losses.

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

Supplementary learning Material:	
1	https://electrical-engineering-portal.com
2	https://www.electrical4u.com
3	https://onlinecourses.nptel.ac.in/noc19_ee62/preview

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**	
15%	30%	20%	25%	10%	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.

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Course Outcomes (CO):

Sr.	Course Outcome Statements	%weightage
CO-1	Define the actual power system structure scenario and its operating mechanism in a state and country with major entities and their functions	**10**
CO-2	Develop proper mathematical model of transmission network for analysis of power flow study, form Static Load Flow Equations, Select and identify the most appropriate numerical technique Solving SLFE	**25**
CO-3	Demonstrate the methods used for voltage and frequency regulation in electrical power network by mathematical analysis	**20**
CO-4	Solve the Unit Commitment problem using Dynamic programming techniques. Analyze the power system economics and factors affecting the economic load dispatch with and without considering network loss	**20**
CO-5	Demonstrate the factors which determine steady state and transient angle stability. Analyze the same for a single machine/infinite bus system using both analytical and graphical (Equal area) methods. Apply numerical technique for stability study	**25**

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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