MOHAMMED SATHAK A J COLLEGE OF ENGINEERING

Siruseri IT park, OMR, Chennai - 603103

LESSON PLAN

Department of Electrical and Electronics Engineering

Name of the Subject	POWER SYSTEM ANALYSIS	Name of the handling Faculty	Mrs.R.Abirami
Subject Code	EE8501	Year / Sem	III/V
Acad Year	2022-23	Batch	2020-24

Course Objective

To model the power system under steady state operating conditon

To understand and aply iterative techniques for power flow analysis

To model and cary out short circuit studies on power system

To model and analyze stabilty problems in power system

Course Outcome

CO1: Model the various power system components and carry out power flow, short circuit and stability studies.

CO2: Apply iterative techniques for power flow analysis.

CO3: Analyse and apply iterative techniques on Fault analysis.

CO4: Model and analyze stability problems in power system.

CO5: Model the power system under steady state operating condition.

Lesson Plan

Sl. No.	Topic(s)	T / R* Book	Periods Required	Mode of Teaching (BB / PPT / NPTEL / MOOC / etc)	Blooms Level (L1-L6)	CO	PO
UNIT I	**POWER SYSTEMS**						
1	Need for System Planning and Operational Studies	T1,T2,T3	1	BB,PPT	L1	CO1	PO1
2	Power Scenario in India	T1,T2,T3	1	BB,PPT	L1	CO1	PO1-PO3
3	Power System Components, Representation	T1,T2,T3	1	BB,PPT	L1	CO1	PO1-PO3
4	Single Line Diagram, Per Unit Quantities	T1,T2,T3	1	BB,PPT	L1	CO1	PO1-PO3
5	P.U. Impedance Diagram, P.U. Reactance Diagram	T1,T2,T3	1	BB,PPT	L4	CO1	PO1-PO5
6	Network Graph, Bus Incidence Matrix	T1,T2,T3	1	BB,PPT	L3	CO1	PO1-PO5
7	Primitive Parameters, Bus Admittance Matrix from Primitive Parameters	T1,T2,T3	1	BB,PPT	L3	CO1	PO1-PO5
8	Representation of Off Nominal Transformer	T1,T2,T3	1	BB,PPT	L3	CO1	PO1-PO3
9	Formation of Bus Admittance Matrix of Large Power Network	T1,T2,T3	1	BB,PPT	L3	CO1	PO1-PO3

Suggested Activity: Assignment / Case Studies / Tuorials/ Quiz / Mini Projects / Model Developed/others Planned if any

MCQ on Power System P.U. Impedance Diagram

Evaluation method :

MCQ on Power System P.U. Impedance Diagram Marks

UNIT II	**POWER FLOW ANALYSIS**						
10	Bus classification	T1,T2,T3,R2	1	BB,PPT	L1	CO1	PO1
11	Formulation of Power Flow problem in polar coordinates	T1,T2,T3,R2	1	BB,PPT	L2	CO2	PO1-PO4
12	Power flow solution using Gauss Seidel method	T1,T2,T3,R2	1	BB,PPT	L3	CO2	PO1-PO4
13	Problems in GS Method	T1,T2,T3,R2	2	BB,PPT	L4	CO2	PO1-PO4
14	Handling of Voltage controlled buses	T1,T2,T3,R2	1	BB,PPT	L3	CO2	PO1-PO4
15	Power Flow Solution by Newton Raphson method.	T1,T2,T3,R2	1	BB,PPT	L3	CO2	PO1-PO4
16	Problems in NR Method	T1,T2,T3,R2	2	BB,PPT	L3	CO2	PO1-PO4
Suggested Activity: Assignment / Case Studies / Tuorials/ Quiz / Mini Projects / Model Developed/others Planned if any Case Study : Characteristics of Wind Turbine Generators for Wind Power Plants.							
Evaluation method Case Study Assignment : Characteristics of Wind Turbine Generators for Wind Power Plants.							
UNIT III	**SYMMETRICAL FAULT ANALYSIS**						
17	Assumptions in short circuit analysis	T1,T2,T3,R2	1	BB,PPT	L2	CO1	PO1-PO5
18	Symmetrical short circuit analysis using Thevenin's theorem	T1,T2,T3,R2	1	BB,PPT	L2	CO3	PO1-PO5
19	Bus Impedance matrix building algorithm (without mutual coupling)	T1,T2,T3,R2	1	BB,PPT	L3	CO3	PO1-PO5
20	Problem	T1,T2,T3,R2	1	BB,PPT	L3	CO3	PO1-PO5
21	Symmetrical fault analysis through bus impedance matrix	T1,T2,T3,R2	1	NPTEL	L4	CO3	PO1-PO5
22	Problem	T1,T2,T3,R2	1	BB,PPT	L3	CO3	PO1-PO5
23	Post fault bus voltages	T1,T2,T3,R2	1	BB,PPT	L3	CO3	PO1-PO5, PO7
24	Fault level	T1,T2,T3,R2	1	BB,PPT	L3	CO3	PO1-PO5, PO7
25	Current limiting reactors.	T1,T2,T3,R2	1	BB,PPT	L2	CO3	PO1-PO5, PO7
Suggested Activity: Assignment / Case Studies / Tuorials/ Quiz / Mini Projects / Model Developed/others Planned if any Case Study : Why are arcing (high-impedance) faults more difficult to detect than low-impedance faults?							
Evaluation method Case Study Assignments on high-impedance faults.							
UNIT IV	**UNSYMMETRICAL FAULT ANALYSIS**						
26	Symmetrical components, Sequence impedances, Sequence networks	T1,T2,T3,R2	1	BB,PPT	L3	CO3	PO1-PO5
27	Analysis of unsymmetrical faults at generator terminals, LG Analysis	T1,T2,T3,R2	1	BB,PPT	L3	CO3	PO1-PO7
28	Problem	T1,T2,T3,R2	1	BB,PPT	L3	CO3	PO1-PO7
29	LL Analysis	T1,T2,T3,R2	1	BB,PPT	L3	CO3	PO1-PO7
30	Problem	T1,T2,T3,R2	1	BB,PPT	L3	CO3	PO1-PO7

31	LLG Analysis	T1,T2,T3,R2	1	BB,PPT	L3	CO3	PO1-PO7
32	Problem	T1,T2,T3,R2	1	BB,PPT	L3	CO3	PO1-PO7
33	Unsymmetrical fault occurring at any point in a power system	T1,T2,T3,R2	1	BB,PPT	L3	CO3	PO1-PO5
34	Computation of post fault currents in symmetrical component and phasor domains.	T1,T2,T3,R2	1	BB,PPT	L3	CO3	PO1-PO5

Suggested Activity: Assignment / Case Studies / Tuorials/ Quiz / Mini Projects / Model Developed/others Planned if any
Tutorial : LG, LL Analysis

Evaluation method
Tutorial : LG, LL Analysis

UNIT V STABILITY ANALYSIS

35	Classification of power system stability	T1,T2,T3,R2	1	BB,PPT	L1	CO1	PO1-PO5
36	Rotor angle stability	T1,T2,T3,R2	1	BB,PPT	L2	CO4	PO1-PO5
37	Swing equation	T1,T2,T3,R2	1	BB,PPT	L2	CO4	PO1-PO5
38	Swing curve	T1,T2,T3,R2	1	BB,PPT	L2	CO4	PO1-PO5
39	Power-Angle equation	T1,T2,T3,R2	1	BB,PPT	L2	CO4	PO1-PO5
40	Equal area criterion	T1,T2,T3,R2	1	NPTEL	L3	CO4	PO1-PO5
41	Critical clearing angle and time	T1,T2,T3,R2	1	BB,PPT	L3	CO5	PO1-PO5
42	Classical step-by-step solution of the swing equation	T1,T2,T3,R2	1	BB,PPT	L3	CO5	PO1-PO5
43	Modified Euler method	T1,T2,T3,R2	1	BB,PPT	L3	CO5	PO1-PO5, PO7, PO12

Suggested Activity: Assignment / Case Studies / Tuorials/ Quiz / Mini Projects / Model Developed/others Planned if any
Assignment on Real-Time Dynamic Security Assessment

Evaluation method: Assignment on Real-Time Dynamic Security Assessment

Content Beyond the Syllabus Planned

1	The Future of Power Transmission
2	Power system state estimation

Text Books

1	John J. Grainger, William D. Stevenson, Jr, ‘Power System Analysis’, Mc Graw Hill Education (India) Private Limited, New Delhi, 2015.
2	Kothari D.P. and Nagrath I.J., ‘Power System Engineering’, Tata McGraw-Hill Education, Second Edition, 2008.
3	Hadi Saadat, ‘Power System Analysis’, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 21st reprint, 2010.

Reference Books

1	Pai M A, ‘Computer Techniques in Power System Analysis’, Tata Mc Graw-Hill Publishing Company Ltd., New Delhi, Second Edition, 2007.
2	J. Duncan Glover, Mulukutla S.Sarma, Thomas J. Overbye, ‘Power System Analysis & Design’, Cengage Learning, Fifth Edition, 2012.
3	Gupta B.R., ‘Power System - Analysis and Design’, S. Chand Publishing, 2001.
4	Kundur P., ‘Power System Stability and Control’, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 10th reprint, 2010.

Website / URL References	
1	https://nptel.ac.in/courses/108/105/108105067/
2	https://onlinecourses.nptel.ac.in/noc19_ee62/preview

Blooms Level

Level 1 (L1) : Remembering	Lower Order Thinking	Fixed Hour Exams	Level 4 (L4) : Analysing		Higher Order Thinking	Projects / Mini Projects
Level 2 (L2) : Understanding			Level 5 (L5) : Evaluating			
Level 3 (L3) : Applying			Level 6 (L6) : Creating			

Mapping syllabus with Bloom's Taxonomy LOT and HOT

Unit No	Unit Name	L1	L2	L3	L4	L5	L6	LOT	HOT	Total
Unit 1	**Power systems**	4	0	4	1	0	0	8	1	9
Unit 2	**Power Flow Analysis**	1	1	4	1	0	0	6	1	7
Unit 3	**Symmetrical Fault Analysis**	0	3	5	1	0	0	8	1	9
Unit 4	**Unsymmetrical Fault Analysis**	0	0	9	0	0	0	9	0	9
Unit 5	**Stability Analysis**	1	4	4	0	0	0	9	0	9
Total		6	8	26	3	0	0	40	3	43
Total Percentage		13.95	18.60	60.47	6.98	0.00	0.00	93.02	6.98	100.00

CO PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	PO6	PO7	PO8	PO9	PO10	PO11	PO12	**PSO1**	**PSO2**
CO1	3	2	2	1	1								2	1
CO2	3	2	2	2									2	1
CO3	3	3	2	2	1	1	1						2	1
CO4	2	2	2	2	1								2	1
CO5	2	1	1	1	1	1	1					1	2	1
Avg	**2.6**	**2**	**1.8**	**1.6**	**0.8**	**0.4**	0.4					0.2	2	**1**

Justification for CO-PO mapping

CO1	High correlation for PO1, medium correlation for PO2,PO3 and low correlation for PO4, PO5 and the CO1 can be used to apply knowledge of engineering to Identify, formulate and provide solutions
CO2	High correlation for PO1, medium correlation for PO2,PO3 and PO4 and PSO1 can be used to apply knowledge of engineering to Identify , formulate and provide solutions by using relevant techniques and tools. PSO1 provides acquired knowledge in conventional energy systems.
CO3	High correlation for PO1, PO2, medium correlation for PO3,PO4 and low correlation for PO5, PO6, PO7 and PSO1 Comes with solutions for the complex problems in conventional energy systems Fault analysis.
CO4	Medium correlation for PO1, PO2, PO3, PO4 and PO5 and PSO1 Comes with solutions for the complex problems in conventional Steady state energy systems.
CO5	High correlation for PO12 and Low correlation for PO1, PO2, PO3, PO4, PO5, PO6 and PO7 and PSO1 Comes with solutions for the complex problems in power system under steady state.

3	**High level**	**2**	Moderate level	1	Low level

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Name & Sign of Subject Expert : Dr.J.Jeha

Head of the Department : Dr.J.Jeha

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