SARDAR RAJA COLLEGE OF ENGINEERING, ALANGULAM

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

MICRO LESSON PLAN

SUBJECT : POWER SYSTEM ANALYSIS

CODE : EE2351

CLASS : III Year / VI SEM

STAFF NAME : K.ARCHUNARAJA

ASSISTANT PROFESSOR/EEE

EE2351 POWER SYSTEM ANALYSIS L T P C 3 1 0 4

UNIT I INTRODUCTION 9

Modern power system (or) electric energy system - Analysis for system planning and operational studies – basic components of a power system. Generator models - transformer model – transmission system model - load representation. Single line diagram – per phase and per unit representation – change of base. Simple building algorithms for the formation of Y-Bus matrix and Z- Bus matrix.

UNIT II POWER FLOW ANALYSIS 9

Importance of power flow analysis in planning and operation of power systems. Statement of power flow problem - classification of buses into P-Q buses, P-V (voltage-controlled) buses and slack bus. Development of Power flow model in complex variables form and polar variables form. Iterative solution using Gauss-Seidel method including Q-limit check for voltage-controlled buses – algorithm and flow chart. Iterative solution using Newton-Raphson (N-R) method (polar form) including Q-limit check and bus switching for voltage-controlled buses - Jacobian matrix elements – algorithm and flow chart. Development of Fast Decoupled Power Flow (FDPF) model and iterative solution – algorithm and flowchart; Comparison of the three methods.

UNIT III FAULT ANALYSIS – BALANCED FAULTS 9

Importance short circuit (or) for fault analysis - basic assumptions in fault analysis of power systems.Symmetrical (or) balanced three phase faults – problem formulation – fault analysis using Z-bus matrix – algorithm and flow chart. Computations of short circuit capacity, post fault voltage andcurrents.

UNIT IV FAULT ANALYSIS – UNBALANCED FAULTS 9

Introduction to symmetrical components – sequence impedances – sequence networks – representation of single line to ground, line to line and double line to ground fault conditions.Unbalanced fault analysis - problem formulation – analysis using Z-bus impedance matrix –(algorithm and flow chart.).

UNIT V STABILITY ANALYSIS 9

Importance of stability analysis in power system planning and operation - classification of powersystem stability - angle and voltage stability – simple treatment of angle stability into small-signal andlarge-signal (transient) stabilitySingle Machine Infinite Bus (SMIB) system: Development of swing equation - equal area criterion - determination of critical clearing angle and time by using modified Euler method and Runge-Kutta second order method. Algorithm and flow chart.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Hadi Saadat, 'Power System Analysis', Tata McGraw Hill Publishing Company, New Delhi, 2002.
2. Olle. I. Elgerd, 'Electric Energy Systems Theory – An Introduction', Tata McGraw Hill Publishing Company Limited, New Delhi, Second Edition, 2003.

REFERENCES:

1. P. Kundur, 'Power System Stability and Control, Tata McGraw Hill, Publications, 1994.
2. John J. Grainger and W.D. Stevenson Jr., 'Power System Analysis', McGraw Hill International Book Company, 1994.
3. I.J. Nagrath and D.P. Kothari, 'Modern Power System Analysis', Tata McGraw-Hill Publishing Company, New Delhi, 1990.
4. .K.Nagasarkar and M.S. Sukhija Oxford University Press, 2007.

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SUBJECT DESCRIPTION AND OBJECTIVES

DESCRIPTION

An electric power system is made up of electrical components to generate, transmit and use electric power. This could be the elaborate network that supplies power to a region's home and industry through an electrical grid transmission system from generating plants located faraway. The majority of these systems rely upon three-phase AC power - the standard for large-scale power transmission and distribution across the modern world. Specialised power systems are also found in aircraft, electric rail systems, ocean liners and automobiles that do not always rely upon three-phase AC power. The planning, design, and operation of these commercial and industrial power systems requires indepth engineering studies to evaluate existing and proposed system performance, reliability, safety, and economics.

OBJECTIVES:

- To model the power system under steady state operating condition. To apply efficient numerical methods to solve the power flow problem.
- To model and analyse the power systems under abnormal (or) fault conditions.
- To model and analyse the transient behaviour of power system when it is subjected to a fault.

MICRO LESSON PLAN

Hours	LECTURE TOPICS	READING
UNIT I - INTRODUCTION		
1	Modern power system (or) electric energy system - Analysis for system planning and operational studies	T1
2	Basic Components of a power system (AV class)	T1
3	Generator models - Transformer model (AV class)	T1
4	Transmission system model - Load representation	T1
5	Single line diagram	T1
6	Per phase and per unit representation	T1
7	Change of base	T1
8	Simple building algorithms for the formation of Y-bus	T1
9	Simple building algorithms for the formation of Z-bus	T1
10,11,12	Tutorial	T1
UNIT II - POWER FLOW ANALYSIS		
13	Importance of power flow analysis in planning and operation of power systems - Statement of power flow problem	T1
14	Classification of buses into P-Q, P-V (voltage controlled bus) and slack bus (AV class)	T1
15	Development of Power flow model in complex variables form and polar variables form	T1
16,17	Iterative solution using Gauss-Seidel method including Q-limit check for voltage-controlled buses – Algorithm and flow chart	T1 & R3
18,19	Iterative solution using Newton-Raphson (N-R) method (polar form) including Q-limit check and bus switching for voltage-controlled buses	T1 & R3
20	Jacobian matrix elements – Algorithm and flow chart	T1 & R3
21	Development of Fast Decoupled Power Flow (FDPF) model and iterative solution – Algorithm and flowchart Comparison of the three methods	T1 & R3
22,23,24	Tutorial	T1 & R3
UNIT III - FAULT ANALYSIS – BALANCED FAULTS		
25	Importance short circuit (or) for fault analysis	T1
26	Basic assumptions in fault analysis of power systems (AV class)	T1
27	Symmetrical (or) balanced three phase faults (AV class)	T1
28	Problem formulation	T1
29	Fault analysis using Z-bus matrix	T1 & R3
30	Algorithm and flow chart	T1 & R3
31	Computations of short circuit capacity	T1

32	Computations of post fault voltage	T1
33	Computations of currents	T1
34,35,36	Tutorial	T1
UNIT IV - FAULT ANALYSIS – UNBALANCED FAULTS		
37	Introduction to symmetrical components (AV class)	T1
38	Sequence impedances	T1
39	Sequence networks	T1
40	Representation of single line to ground fault	T1 & R3
41	Representation of line to line fault	T1 & R3
42	Representation of double line to ground fault	T1 & R3
43	Unbalanced fault analysis	T1 & R3
44	Problem formulation	T1 & R3
45	Analysis using Z-bus impedance matrix – (algorithm and flow chart)	T1 & R3
46,47,48	Tutorial	T1 & R3
UNIT V - STABILITY ANALYSIS		
49	Importance of stability analysis in power system planning and operation	T1
50	Classification of power system stability	T1
51	Angle and voltage stability	T1
52	Simple treatment of angle stability into small-signal and large-signal (transient) stability	T1
53	Single Machine Infinite Bus (SMIB) system - Development of swing equation (AV class)	T1
54	Equal area criterion	T1 & R3
55,56	Determination of critical clearing angle and time by using modified Euler method	T1 & R3
57	Determination of critical clearing angle and time by using Runge-Kutta second order method Algorithm and flow chart.	T1 & R3
58,59,60	Tutorial	T1 & R3