POWER SYSTEM ANALYSIS

VI Semester: EEE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEE012	Core	3	1	-	4	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

OBJECTIVES:

The course should enable the students to:

I Determine the bus impedance and admittance matrices for power system network.

II Calculate various parameters at different buses using load flow studies and numerical methods.

III Discuss the symmetrical component theory, sequence networks, short circuit calculations and per unit representation power system.

IV Understand the steady state stability of power system and suggest improvements.

V Analyze the transient stability of power system and check methods to improve the stability.

COURSE OUTCOMES (COs):

The course should enable the students to:

I Formulate the bus impedance and admittance matrices for complex power system networks.

II Identify unknown electrical quantity at various buses of power system and estimate.

III Determine effect of symmetrical and unsymmetrical faults on power system in per unit system.

IV Check the effect of slow and gradual change in load on power system and check the methods of improvement.

V Discuss the characteristics of power system under large disturbances and methods to improve transient stability.

COURSE LEARNING OUTCOMES (CLOs):

Students, who complete the course, will have demonstrated the ability to do the following:

1 Define the basic terminology of graph theory to form bus impedance and admittance matrices.

2 Determine the bus impedance and admittance matrices for power system.

3 Draw the algorithms to form the bus impedance and admittance matrices for various configuration of primitive network.

4 Understand necessity of load flow studies and derive static load flow equations.

5 Use different numerical methods to determine unknown parameters at various buses and to draw relevant algorithms.

6 Compare various numerical methods of load flow studies and analyze DC load flow studies.

7 Draw the equivalent reactance network of three phase power system using per unit system.

8 Calculate the electrical parameters under symmetrical fault conditions and understand symmetrical component theory.
9 Compute the electrical parameters under unsymmetrical faults with and without fault impedance.
10 Discuss the steady state stability, dynamic stability and transient stability of power system.
11 Describe steady state stability power limit, transfer reactance, synchronizing power coefficient, power angle curve.
12 Determination of steady state stability and methods to improve steady state stability of power system.
13 Derive the swing equation to study steady state stability of power system.
14 Predict the transient state stability of power system using equal area criteria and solution of swing equation.
15 Suggest the methods to improve transient stability, discuss application of auto reclosing and fast operating circuit breakers.
16 Apply the concept of graph theory, numerical methods, symmetrical and unsymmetrical fault to understand steady state and transient analysis.
17 Explore the knowledge and skills of employability to succeed in national and international level competitive examinations.

Unit-I	**POWER SYSTEM NETWORK MATRICES**	**Classes: 09**

Graph Theory: Definitions, bus incidence matrix, Y bus formation by direct and singular transformation methods, numerical problems; Formation of Z Bus: Partial network, algorithm for the modification of Z bus matrix for addition of element from a new bus to reference bus, addition of element from a new bus to an old bus, addition of element between an old bus to reference bus and addition of element between two old busses (Derivations and Numerical Problems), modification of Z bus for the changes in network (Numerical Problems).

Unit -II	**POWER FLOW STUDIES AND LOAD FLOWS**	**Classes: 09**

Load flows studies: Necessity of power flow studies, data for power flow studies, derivation of static load flow equations; Load flow solutions using Gauss Seidel method: Acceleration factor, load flow solution with and without PV buses, algorithm and flowchart; Numerical load flow solution for simple power systems (Max. 3 buses): Determination of bus voltages, injected active and reactive powers (Sample one iteration only) and finding line flows / losses for the given bus voltages; Newton Raphson method in rectangular and polar coordinates form: Load flow solution with or without PV busses derivation of Jacobian elements, algorithm and flowchart, decoupled and fast decoupled methods, comparison of different methods, DC load flow study.

Unit -III	**SHORT CIRCUIT ANALYSIS PER UNIT SYSTEM OF REPRESENTATION**	**Classes: 09**

Per unit system: Equivalent reactance network of a three phase power system, numerical problems; Symmetrical fault analysis: Short circuit current and MVA calculations, fault levels, application of series reactors, numerical problems; Symmetrical component theory: Symmetrical component transformation, positive, negative and zero sequence components, voltages, currents and impedances.
Sequence networks: Positive, negative and zero sequence networks, numerical problems; Unsymmetrical fault analysis: LG, LL, LLG faults with and without fault impedance, numerical problems.

Unit -IV	**STEADY STATE STABILITY ANALYSIS**	**Classes: 09**

Steady state stability: Elementary concepts of steady state, dynamic and transient stabilities, description of steady state stability power limit, transfer reactance, synchronizing power coefficient, power angle curve and determination of steady state stability and methods to improve steady state stability.

Unit -V	TRANSIENT STATE STABILITY ANALYSIS	Classes: 09

Swing equation: Derivation of swing equation, determination of transient stability by equal area criterion, application of equal area criterion, critical clearing angle calculation, solution of swing equation, point by point method, methods to improve stability, application of auto reclosing and fast operating circuit breakers.

Text Books:

1. I J Nagrath & D P Kothari, "Modern Power system Analysis", Tata McGraw-Hill Publishing Company, 2nd Edition.
2. M A Pai, "Computer Techniques in Power System Analysis", TMH Publications.
3. B.R.Gupta, " power system analysis and design",S.CHAND publications
4. K Umarao, "Computer techniques and models in power systems", I K International Pvt. Ltd.

Reference Books:

1. Stagg , El Abiad, " Computer Methods In Power System". Tata McGraw-Hill.1968.
2. Grainger and Stevenson, "Power System Analysis", Tata McGraw-Hill, 3rd Edition, 2011.
3. J Duncan Glover and M S Sarma., THOMPSON, "Power System Analysis and Design", 3rd Edition 2006.
4. Abhijit Chakrabarthi and Sunita Haldar, "Power system Analysis Operation and control", 3rd Edition, PHI, 2010.

Web References:

1. https://www.worldcat.org/title/computer-methods-in-power-system-analysis/.../600788826
2. https://www.sjbit.edu.in/.../COMPUTER%20%20TECHNIQUES%20IN%20POWER%20%20SYS..
3. https://www.books.google.com › Technology & Engineering › Electrical
4. https://www.nptel.ac.in/courses/108105067/
5. https://www.jntusyllabus.blogspot.com/2012/01/computer-methods-power-systems-syllabus.html

E-Text Books:

1. https://www.scribd.com/.../Computer-Methods-in-Power-System-Analysis-by-G-W-St...
2. https://www.academia.edu/8352160/Computer_Methods_and_Power_System_Analysis_Stagg
3. https://www.uploady.com/#!/download/ddC9obmVTiv/NwO1AnQrlmogeJjS
4. https://www.materialdownload.in/article/Computer-Methods-in-Power-System-Analysis_159/
5. https://www.ee.iitm.ac.in/2015/07/ee5253/