SREENIVASA INSTITUTE of TECHNOLOGY and MANAGEMENT STUDIES (autonomous)

POWER SYSTEM ANALYSIS

Question bank

III - B.TECH / VI - SEMESTER regulation: R20

Compiled by

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II B.Tech VI Semester	L	T	P	C
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20EEE361 POWER SYSTEM ANALYSIS

Pre-requisites: A Course on Power system Engineering

Course Educational Objectives:

On successful completion of the course, students will be able to

1 Demonstrate knowledge on Per unit representation, symmetrical component theory
2 Analyse the power system networks for the formation of bus impedance and admittance matrices.
3 Evaluate the power system network for various planning strategies and provide a feasible solution.
4 Apply appropriate techniques/methods to analyse power system network operating under various conditions.
5 Apply the conceptual knowledge on power system stability.

UNIT –1 PER UNIT SYSTEMS AND SYMMETRICAL COMPONENT THEORY

Per unit system representation, advantages, per unit equivalent reactance representation of power system components. Symmetrical component theory - voltages, currents and impedances. Sequence representation of power system components- Generators, transformers, transmission line, load and networks.

UNIT – 2: POWER SYSTEM NETWORK MATRICES

Bus admittance matrix - Direct inspection method. Bus impedance matrix- Formation of Z bus matrix for partial network, algorithm for the modification of bus impedance matrix – addition of element from a new bus to reference, new bus to an old bus, between an old bus & reference and between two old buses.

UNIT – 3: POWER FLOW STUDIES

Introduction, derivation of static load flow equations. Load flow solution using Gauss-Seidel method, Newton-Raphson method- with and without PV bus, Decoupled and Fast decoupled methods (maximum of 3-buses for one iteration only). Algorithm and flowcharts, Comparison of different load flow methods.

UNIT – 4: FAULT ANALYSIS

Introduction, Unsymmetrical faults - LG, LL, and LLG - with and without fault impedance. Symmetrical fault - LLL & LLLG faults. Symmetrical fault analysis using Z bus, short circuit current and MVA calculations.

UNIT – 5: POWER SYSTEM STABILITY

Elementary concepts of stability. Steady state stability – power limit, transfer reactance, power angle curve, derivation of swing equation. Transient stability - equal area criterion, applicationscritical clearing angle, critical clearing time. Methods to improve stability - auto re-closure and fast operating circuit breakers

Course Outcomes:

SNO	DESCRIPTION	PO'S & PSO'S
CO.1	Demonstrate knowledge on Per unit representation, symmetrical component theory and sequence network representation of power sytem networks.	PO1,PO2,PO3,PO4&PSO1, PSO2
CO.2	Analyse The power system network for sequence network representation	PO1,PO2,PO3,PO4&PSO1, PSO2
CO.3	Evaluate Per unit quantities for various power system components and netorks	PO1,PO2,PO3,PO4&PSO1, PSO2
CO.4	Apply appropriate techniques/methods to analyse power system network operating under various conditions.	PO1,PO2,PO3,PO4&PSO1, PSO2
CO.5	Apply the conceptual knowledge of power system analysis to assess and analyse a power system for various scenarios. P	PO1,PO2,PO3,PO4&PSO1, PSO2

Text Books:

1.C. L. Wadhwa, "Electrical Power Systems", New Age International(P) Limited publishers, New Delhi, 6th edition, 2010
2. P. Venkatesh, B.V. Manikandan, S. Charles Raja and A. Srinivasan," Electrical power systems analysis", Security and deregulation, PHI learning private limited, Delhi, 2014.

REFERENCE BOOKS:

1. G. W. Stagg and A.H. El-Abiad, Computer Methods in PowerSystem Analysis, Mc Graw-Hill, New Delhi, International studentedition, 1968.
2. John J. Grainger and William D. Stevenson, JR, Power SystemAnalysis, Mc Graw-Hill Education (India) Pvt. Limited, 1994.
3. HadiSaadat, Power System Analysis, Tata Mc Graw-Hill Publishing Company Limited, New Delhi, 2nd edition, 2002.
4. S.A.Nasar "electrical power systems" revised 1st edition

QUESTION BANK

Question No.	Questions	PO Attainment
UNIT – 1: PER UNIT SYSTEM AND SYMMETRICAL COMPONENT THEORY		
PART-A (Two Marks Questions)		
1	Define per unit value.	PO1
2	What are the advantages of per unit system.	PO1
3	What is single line diagram.	PO1
4	Write the equation for converting per unit impedance expressed in one base to another.	PO1
5	What is the need for base values.	PO1
6	What are the quantities whose base values are required to represent the power system by reactance diagram.	PO1
7	Draw the equivalent circuit of a three phase generator.	PO1
8	Draw the equivalent circuit of a synchronous motor.	PO1
9	Draw the equivalent circuit of a transmission line.	PO1
10	Draw the equivalent circuit of a single phase three winding transformer.	PO1
11	How the loads are represented in reactance or impedance diagram.	PO1
12	What is impedance diagram.	PO1
13	What is reactance diagram.	PO1
14	What are the approximations made in impedance diagram.	PO1
15	What are the approximations made in reactance diagram.	PO1
16	Give equations for transforming base KV on LV side to HV side of a transformer and vice versa.	PO1
17	What is symmetrical component theory.	PO1
18	What are the types of sequences.	PO1
19	Draw the equivalent circuit of a induction motor.	PO1
20	Draw the equivalent circuit of a single phase transformer.	PO1
PART-B (Ten Marks Questions)		
1	Derive the equations for base impedance change in base values.	PO1, PO2
2	Explain the procedure of impedance method.	PO1, PO2, PO4
3	Explain the procedure of reactance method.	PO1, PO2
4	Derive the equation for unsymmetrical components to symmetrical components.	PO1, PO2, PO4
5	Derive the equation for symmetrical components to unsymmetrical components	PO1, PO2, PO4
6	Explain the symmetrical component theory.	PO1, PO2, PO4
7	A 300MVA,20KV,3-phase has a sub transient reactance of 20%.The generator supplies 2 synchronous motors through 64 km transmission line having transformer at both ends.in this T1 is 3-phase transformer and T2 is made of 3 single phase transformer of rating 100 MVA127\13.2kv 10% reactance. Series reactance of transmission line 0.5ohm.Draw the reactance diagram	PO1, PO2, PO4

8	A 3-phase generator with rating 1000KVA,33KV has its armature resistance and synchronous reactance as 20ohm\phase and 70ohm\phase.calculate p.u.impedence of the generator	PO1, PO2, PO4

Question No.	Questions	PO Attainment
UNIT – 2: POWER SYSTEM NETWORK MATRICES		
	PART-A (Two Marks Questions)	
1	What is bus.	PO1
2	What is bus admittance matrix.	PO1
3	Name the diagonal and off diagnol elements of bus admittance matrix.	PO1
4	What is bus impedance matrix.	PO1
5	Name the diagonal and off diagnol elements of bus impedance matrix.	PO1
6	What are the methods available for forming bus impedance matrix.	PO1
7	Write the four methods of adding an impedance to an existing system so as to modify bus impedance matrix.	PO1
8	Write the equation for adding element between reference bus to new bus.	PO1
9	Write the equation for adding element between old bus to new bus.	PO1
10	Write the equation for adding element between two old buses.	PO1
	PART-B (Ten Marks Questions)	
1	Explain the procedure to form bus admittance matrix	PO1, PO3
2	Explain the procedure to form bus impedance matrix	PO1, PO3
3	Explain the direct inspection method of bus admittance matrix	PO1, PO3
4	Explain the methods of Z formulation in power system.	PO1, PO2, PO3
5	Determine Zbus for the system whose reactance diagram where the impedance is given in p.u. Draw the circuit diagram of impedance by taking the values of j0.3,0.2j,0.15j,1.5j,1.2j	PO1, PO2, PO3
6	Determine the reduced admittance matrix by eliminating node4.The values are marked in p.u. Draw the matrix diagram with the values of -0.5j,-0.6j,-0.5j,-0.4j,-0.4j	PO1, PO2, PO3
7	Find the bus impedance matrix of the system whose reactance diagram. Draw the circuit diagram and the values are 0.25j,0.05j,1.0j,1.25j.	PO1, PO2, PO3
8	Find the bus admittance matrix of the system. Draw the impedence diagram and values are –j1,-j2,-j5,-j5,j2,j1,-j4.	PO1, PO2, PO3
Question No.	**Questions**	**PO Attainment**
UNIT – 3: POWER FLOW STUDY		
	PART-A (Two Marks Questions)	
1	What is power flow analysis.	PO1
2	Classify the buses.	PO1
3	What is the need of slack bus.	PO1

4	What is acceleration factor.	PO1
5	Write the range of acceleration factor.	PO1
6	What is load bus.	PO1
7	What is generator bus.	PO1
8	What is slack bus.	PO1
9	What are the known and unknown parameters of load bus.	PO1
10	What are the known and unknown parameters of generator bus.	PO1
11	What are the known and unknown parameters of slack bus.	PO1, PO3
12	Write the equation for complex power conjugate.	PO1
13	How a load flow study is performed.	PO1, PO3
14	What are the iterative methods in load flow study.	PO1, PO3
15	Why do we go for iterative methods to solve load flow problems.	PO1
16	Write the load flow equations of a Gauss seidal method.	PO1
17	Write the load flow equations of a Newton Rapshon method.	PO1
18	Write the coordinate equations of a power flow study.	PO1
19	What are the advantages and disadvantages of a Gauss Seidal Method.	PO1
20	What are the advantages and disadvantages of a Newton Rapshon method.	PO, PO3
	PART-B (Ten Marks Questions)	
1	Derive the load flow equations of a Gauss seidal method without pv buses.	PO1, PO3, PO4
2	Derive the load flow equations of a Gauss seidal method with pv buses.	PO1, PO3, PO4
3	Derive the load flow equations of a Newton Rapshon method.	PO1, PO3, PO4
4	Explain the step by step procedure of a Gauss seidal method.	PO1, PO3, PO4
5	Explain the step by step procedure of a Newton Rapshon method.	PO1, PO3, PO4
6	Draw the flow chart of a Gausseidal method considering with an without pv buses.	PO1, PO3, PO4
7	Draw the flow chart of a Newton Rapshon method.	PO1, PO3, PO4
8	Derive the expression for static load flow equations.	PO1, PO3, PO4
9	Derive expression for power equations by using decoupled and fast decoupled method.	PO1, PO3, PO4
10	Compare Gausseidal method,Newton Raphson method and fast decoupled method.	PO1, PO3, PO4

Question No.	Questions	PO Attainment
	UNIT – 4: FAULT ANALYSIS	
	PART-A (Two Marks Questions)	
1	What is meant by fault.	PO1
2	Why fault occur in a power system.	PO1
3	What are the types of faults.	PO1
4	What is symmetrical fault.	PO1, PO2
5	What is unsymmetrical fault.	PO1, PO2

6	What are the methods of reducing short circuit current.	PO1, PO2
7	List the various types of shunt faults.	PO1, PO2
8	List the various types of series faults.	PO1, PO2
9	What is meant by fault calculations.	PO1
10	What is the reason for transients during short circuits.	PO1
11	What is the need for fault analysis.	PO1
12	What is meant by fault calculations.	PO1
13	Write the relative frequency of occurrence of various types of faults.	PO1
14	List the various types of symmetrical faults.	PO1
15	List the various types of unsymmetrical faults.	PO1
16	Write the faults in order of severity.	PO1
17	Write the faults involving ground.	PO1
18	Write the boundary condition in LL fault.	PO1
19	Write the boundary condition in LG fault.	PO1
20	Write the boundary condition in LLG fault.	PO1, PO2
	PART-B (Ten Marks Questions)	
1	Derive the necessary equations of a fault current for single line to ground fault considering impedance.	PO1, PO2, PO3,PO6
2	Derive the necessary equations of a fault current for double line to ground fault considering impedance.	PO1, PO2, PO3,PO6
3	Derive the necessary equations of a fault current for line to line fault considering impedance.	PO1, PO2, PO3,PO6
4	Explain the unsymmetrical faults	PO1, PO2, PO3,PO6
5	Derive the necessary equations of a fault current for single line to ground fault without impedance.	PO1, PO2, PO3,PO6
6	Derive the necessary equations of a fault current for double line to ground fault without impedance.	PO1, PO2, PO3,PO6
7	Derive the necessary equations of a fault current for line to line fault without impedance.	PO1, PO2, PO3,PO6

Question No.	Questions	PO Attainment
	UNIT – 5: STEADY STATE STABILITY	
	PART-A (Two Marks Questions)	
1	Define stability.	PO1
2	Define steady state stability.	PO1
3	Define transient stability.	PO1
4	What is steady state limit.	PO1
5	What is transient stability limit.	PO1
6	How stability studies calssified.what are they.	PO1
7	Write down the units of inertia M &H and their relationship.	PO1
8	Define swing curve.	PO1
9	Write the power angle equation.	PO1
10	Define power angle curve.	PO1
11	What are the improving methods of transient stability.	PO1

12	State equal area criterion.	**PO1**
13	Draw the power angle characteristics.	**PO1**
14	Write the formula for swing curve.	**PO1**
15	Define critical clearing time.	**PO1**
16	Define critical clearing angle.	**PO1**
17	What is the use of swing curve.	**PO1**
18	Define synchronising coefficient.	**PO1**
19	Classify the types of stability.	**PO1**
20	Name the two ways by which transient stability study can be made in a system where one machine is swinging with respect to infinite bus.	**PO1**
	PART-B (Ten Marks Questions)	
1	Explain the critical clearing criteria.	**PO1, PO7**
2	Explain the power angle characteristics of a synchronous machine.	**PO1, PO7**
3	What are the methods to improve transient stability and explain.	**PO1, PO7**
4	Derive the swing equation of a synchronous machine.	**PO1, PO7**
5	Explain the auto-reclosure and fast operating circuit breakers.	**PO1, PO7**
6	Explain the steady state stability.	**PO1, PO7**
7	Explain the solution of swing equation by using point by point method.	**PO1, PO7**

*****ALL THE VERY BEST*****