

# SRM VALLIAMMAI ENGINEERING COLLEGE

SRM Nagar, Kattankulathur – 603 203

## DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

### QUESTION BANK



### V SEMESTER

**EE3561-Power System Analysis**

**Regulation – 2023**

**Academic Year 2025-26 Odd**

*Prepared by*

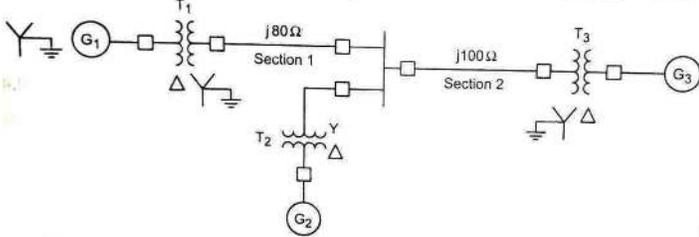
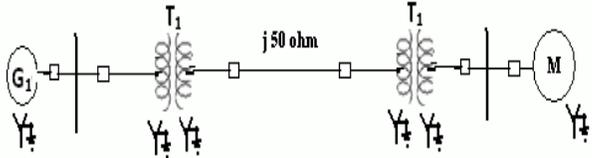
**Dr. K. Elango, Professor and Head / EEE**

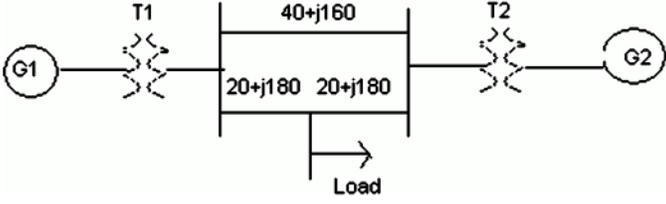
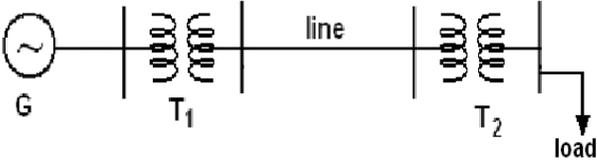
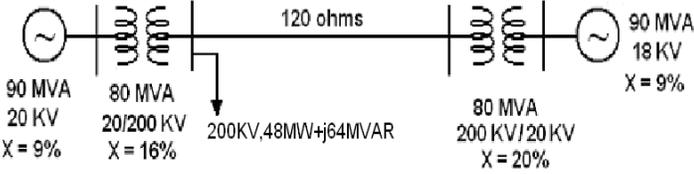
**UNIT I -POWER SYSTEM**

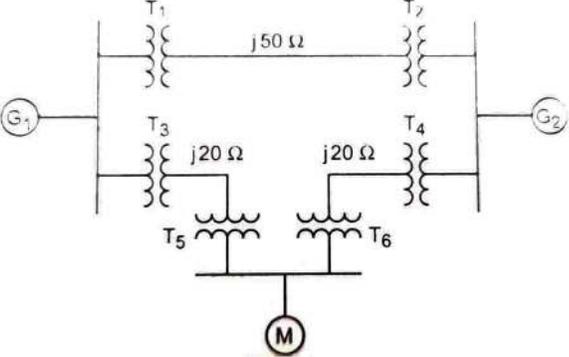
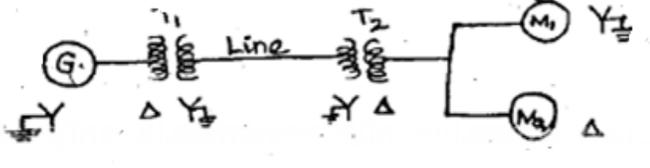
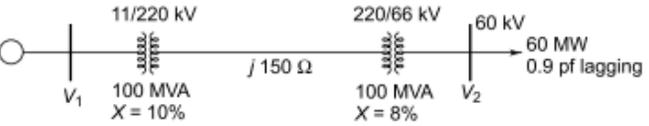
**PART - A (2 Marks)**

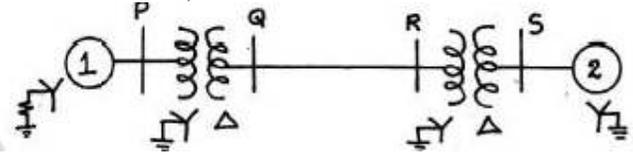
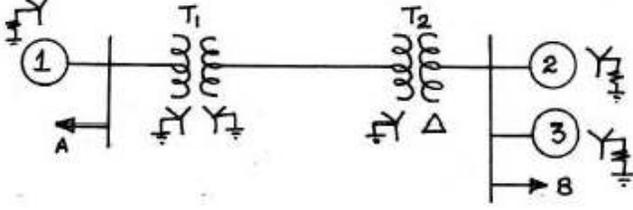
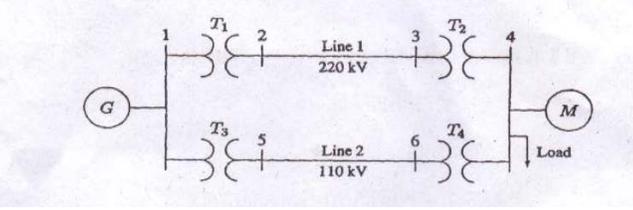
<b>Q.No</b>	<b>Questions</b>	<b>Course Outcome</b>	<b>BT Level</b>	<b>Competence</b>
1	What is meant by base quantities in per unit representation	CO 1	BT-1	Remember
2	What is impedance diagram and what are the approximation made in this diagram	CO 1	BT-2	Understand
3	Define bus admittance matrix, bus impedance matrix?	CO 1	BT-1	Remember
4	A generator rated 25MVA, 11KV has a reactance of 15%. Calculate its p.u. reactance for a base of 50 MVA and 10KV	CO 1	BT-6	Create
5	What is single line diagram	CO 1	BT-2	Understand
6	Prepare the single-phase equivalent circuit of three winding transformer	CO 1	BT-3	Apply
7	Point out the approximations made in the impedance diagram?	CO 1	BT-4	Analyze
8	Write equation for per unit impedance if change base occurs	CO 1	BT-3	Apply
9	What is the need of base values	CO 1	BT-1	Remember
10	Contrast the $\pi$ circuit representation of a transformer with off – nominal ratio ' $\alpha$ '	CO 1	BT-4	Analyze
11	What is the function of modern power system	CO 1	BT-2	Understand
12	How are the loads are represented in the reactance and impedance diagram	CO 1	BT-4	Analyze
13	Summarize the functions of power system analysis?	CO 1	BT-2	Understand
14	Examine the applications of Y-bus	CO 1	BT-5	Evaluate
15	Define Network graph.	CO 1	BT-1	Remember
16	Define off nominal transformer ratio?	CO 1	BT-1	Remember
17	Define a primitive network?	CO 1	BT-1	Remember
18	Order the methods available for forming bus admittance matrix	CO 1	BT-5	Evaluate
19	Define Bus incidence matrix.	CO 1	BT-1	Remember
20	What is installed capacity of electrical power in India	CO 1	BT-1	Remember
21	Prepare the list of advantages and disadvantages of sparse matrices in power systems.	CO 1	BT-4	Analyze
22	Define sparse matrix.	CO 1	BT-2	Understand
23	The per unit impedance of a circuit element is 0.30. If the base kV and base MVA are halved, then the new value of the per unit impedance of the circuit element will be?	CO 1	BT-4	Analyze
24	The per unit value of a 2-ohm resistor at 100 MVA base and 10 kV base voltage is	CO 1	BT-4	Analyze

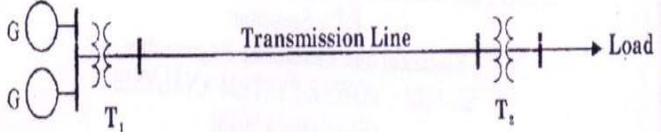
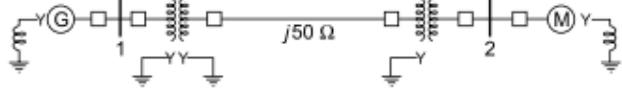
**PART - B (16 Marks)**

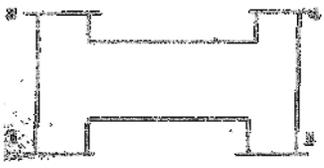
<p>1</p>	<p>The single line diagram of a simple power system is shown in Fig. The rating of the generators and transformers are given below:          Generator 1: 20 MVA, 13.8kV, <math>X''=20\%</math>          Generator 2: 30 MVA, 18.0kV, <math>X=20\%</math>          Generator 3: 30 MVA, 20.0kV, <math>X=20\%</math>          Transformer 1: 25 MVA, 13.8/220 kV, <math>X=10\%</math>          Transformer2: 3 Single phase units each rated 10MVA, 127/18 kV, <math>X=10\%</math>          Transformers 3: 35 MVA, 220/22 kV, <math>X=10\%</math>          Examine the impedance diagram and mark all values in p.u choosing a base of 50 MVA, 13.8 kV in the generator 1 circuit.</p> 	<p>CO 1</p>	<p>BT-2</p>	<p>Understand</p>
<p>2</p>	<p>Examine the reactance diagram for the power system shown in fig. Neglect resistance and use a base of 100MVA, 220kV in 50Ω line. The ratings of the generator motor and transformer are given below.</p>  <p>Generator: 40 MVA, 25kV, <math>X'' = 20\%</math>.          Synchronous Motor: 50 MVA, 11kV, <math>X'' = 30\%</math>          T1: Y-Y transformer: 40 MVA 33/220 kV, <math>X=15\%</math>          T2: Y- Y transformer: 30 MVA 11/220kV, <math>X=15\%</math></p>	<p>CO 1</p>	<p>BT-3</p>	<p>Apply</p>

3	<p>Prepare a per phase schematic of the system in fig. and show all the impedance in per unit on a 100 MVA, 132 KV base in the transmission line circuit. The necessary data are Given as follows.</p> <p>G1 : 50 MVA, 12.2KV, <math>X=0.15</math> pu.  G2 : 20 MVA, 13.8KV, <math>X=0.15</math> pu.  T1 : 80 MVA, 12.2/161KV, <math>X=0.1</math> pu. T2 : 40 MVA, 13.8/161KV, <math>X=0.1</math> pu.  LOAD: 50 MVA, 0.8 power factor lag operating at 154 kV.  Evaluate the p.u impedance of the load.</p> 	CO 1	BT-2	Understand
4	<p>Give p.u impedance diagram of the power system of figure. Choose base quantities as 15 MVA and 33 KV.</p> <p>Generator: 30 MVA, 10.5 KV, <math>X'' = 1.6</math> ohms.  Transformers T1 &amp; T2 : 15 MVA, 33/11 KV, <math>X = 15</math> ohms referred to HV  Transmission line: 20 ohms / phase.  Load: 40 MW, 6.6 KV, 0.85 lagging p.f.</p> 	CO 1	BT-4	Analyze
5	<p>Draw the p.u impedance diagram for the system shown in figure. Choose Base MVA as 100 MVA and Base KV as 20 KV.</p> 	CO 1	BT-5	Evaluate

<p>6</p>	<p>Draw the reactance diagram for the power system shown in figure. The ratings of generator, motor and transformers are given below. Neglect resistance and use a base of 30 MVA, in the 50 ohm line</p>  <p>Generator <math>G_1</math>: 50 MVA, 11kV, <math>X''=14\%</math>  Generator <math>G_2</math>: 50 MVA 11kV, <math>X''=16\%</math>  Synchronous motor: 20 MVA, 11kV, <math>X''=15\%</math>  <math>T_1, T_2, T_3, T_4</math>: 30 MVA, 66/11 kV, <math>X=12\%</math>.  <math>T_5, T_6</math>: 15 MVA, 66/11 kV, <math>X=10\%</math>.</p>	<p>CO 1</p>	<p>BT-1</p>	<p>Remember</p>
<p>7</p>	<p>A 90 MVA 11KV 3<math>\Phi</math> generator has a reactance of 25%. The generator supplies two motors through transformer and transmission line as shown in fig. The transformer T1 is a 3<math>\Phi</math> transformer, 100 MVA, 10/132 KV, 6% reactance. The transformer T2 is composed of 3 single phase units each rated, 300 MVA, 66/20 KV, with 5% reactance. The connection of T1 and T2 are shown in fig. The motors are rated at 50 MVA and 400 MVA with both 10KV and 20% reactance. Taking the generator rating as base. Show reactance diagram. Reactance of the line is 100<math>\Omega</math>.</p> 	<p>CO 1</p>	<p>BT-5</p>	<p>Evaluate</p>
<p>8</p>	<p>Figure shows the schematic diagram of a radial transmission system. The ratings and reactance of the various components are shown there in. A load of 60 MW at 0.9 power factor lagging is tapped from the 66 kV substation which is to be maintained at 60 kV. Calculate the terminal voltage of the synchronous machine. Represent the transmission line and the transformers by series reactance only.</p> 	<p>CO 1</p>	<p>BT-3</p>	<p>Apply</p>

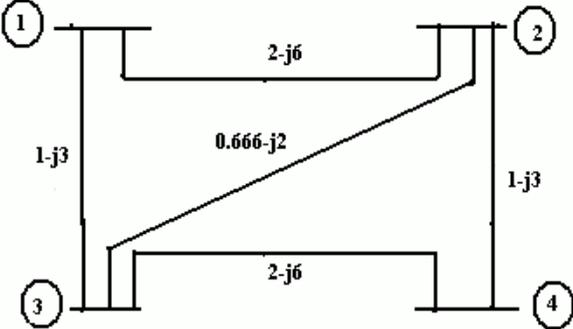
9	<p>One line diagram of a simple power system is given below. Draw the zero sequence network.</p> <p>The zero sequence reactance of the various components are denoted as follows:  Generator 1 = <math>X_{10}</math>, Transformer <math>XT_1</math> <math>\square</math> and line = <math>X_l</math>.  Generator 2 = <math>X_{20}</math>, Transformer <math>XT_2</math> <math>\square</math></p> 	CO 1	BT-2	Understand
10	<p>Obtain the per unit reactance diagram of the power system shown below.</p> <p>Specifications of the system components are  Generator 1: 30 MVA, 10.5 kV, <math>X_{\square} = 1.6\Omega</math>  Generator 2: 15 MVA, 6.6 kV, <math>X_{\square} = 1.2\Omega</math>  Generator 3: 25 MVA, 6.6 kV, <math>X_{\square} = 0.56\Omega</math>  Transformer <math>T_1</math>: 15MVA, 11/33 kV, <math>X = 15.2\Omega</math> per phase on HV side  Transformer <math>T_2</math>: 15MVA, 33/6.2 kV, <math>X = 16\Omega</math> per phase on HV side,  Transmission Line: 20.5 ohms per phase  Load A: 15MW, 11 kV, 0.9 pf lag and Load B: 6.2 kV, 34 MW+j20.07MVAR.</p> 	CO 1	BT-5	Evaluate
11	<p>The one diagram of the three phase power system in figure. Select a common base of 100MVA and 22kV on generator side draw the impedance diagram in per unit</p> <p>The three phase load at bus 4 absorbs 57 MVA, 0.6 power factor lagging at 10.45kV. Line 1 and line 2 reactance of 48.4 <math>\Omega</math> and 65.43 <math>\Omega</math> respectively</p> <p>G : 90 MVA, 22 KV, <math>X = 18\%</math>; T1 : 50 MVA, 22/220 KV, <math>X = 10\%</math>  T2 : 40 MVA, 22/220 KV, <math>X = 6\%</math>; T3 : 40 MVA, 220/110 KV, <math>X = 6.4\%</math>  T4 : 40 MVA, 110/11 KV, <math>X = 8\%</math>; M : 66.5 MVA, 10.45 KV, <math>X = 18.5\%</math></p> 	CO 1	BT-5	Evaluate

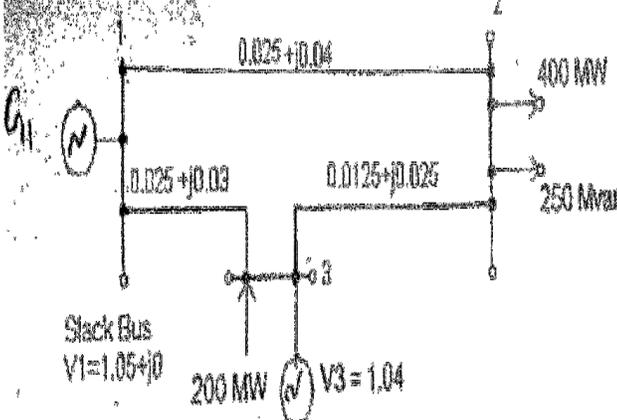
12	<p>In this line diagram shown in figure each three phase generator G is rated at 200 MVA, 13.8kV and has reactance of 0.85p.u and is generating 1.15pu. Transformer T1 is rated 500 MVA,13.5kV/220kV and has reactance of 0.8%.The transmission line has a reactance of 7.8Ω.Transformer T2 has rating of 400 MVA,220kV/33kV and a reactance of 11%.The load is 250 MVA at a power factor of 0.85lag.Convert all quantities to a common base of 500 MVA and 220kV on the line and draw the circuit diagram with values expressed in pu</p> 	CO 1	BT-6	Create																														
13	<p>Draw the pu impedance diagram for the power system shown in Fig. Neglect resistance, and use a base of 100 MVA, 220 kV in 50 W line. The ratings of the generator, motor and transformers are  Generator 40 MVA, 25 kV, <math>X'' = 20\%</math>  Motor 50 MVA, 11 kV, <math>X'' = 30\%</math>  Y-Y transformer, 40 MVA, 33 Y -220 Y kV, <math>X = 15\%</math>  Y-D transformer, 30 MVA, 11 D-220 Y kV, <math>X = 15\%</math></p> 	CO 1	BT-5	Evaluate																														
14	<p>The parameters of a four system are as under:</p> <table border="1" data-bbox="277 1020 979 1360"> <thead> <tr> <th>Line No.</th> <th>Line starting bus</th> <th>Line ending bus</th> <th>Line impedance(pu )</th> <th>Line Charging Admittance(pu)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>1</td> <td>2</td> <td>0.2+j0.8</td> <td>j0.02</td> </tr> <tr> <td>2</td> <td>2</td> <td>3</td> <td>0.3+j0.9</td> <td>j0.03</td> </tr> <tr> <td>3</td> <td>2</td> <td>4</td> <td>0.25+j1.0</td> <td>j0.04</td> </tr> <tr> <td>4</td> <td>3</td> <td>4</td> <td>0.2+j0.8</td> <td>j0.02</td> </tr> <tr> <td>5</td> <td>1</td> <td>3</td> <td>0.1+j0.4</td> <td>j0.01</td> </tr> </tbody> </table> <p>Point out the Network and find the bus admittance matrix.</p>	Line No.	Line starting bus	Line ending bus	Line impedance(pu )	Line Charging Admittance(pu)	1	1	2	0.2+j0.8	j0.02	2	2	3	0.3+j0.9	j0.03	3	2	4	0.25+j1.0	j0.04	4	3	4	0.2+j0.8	j0.02	5	1	3	0.1+j0.4	j0.01	CO 1	BT-3	Apply
Line No.	Line starting bus	Line ending bus	Line impedance(pu )	Line Charging Admittance(pu)																														
1	1	2	0.2+j0.8	j0.02																														
2	2	3	0.3+j0.9	j0.03																														
3	2	4	0.25+j1.0	j0.04																														
4	3	4	0.2+j0.8	j0.02																														
5	1	3	0.1+j0.4	j0.01																														
15	<p>The parameter of a 4 bus system are as under</p> <table border="1" data-bbox="266 1486 915 1688"> <thead> <tr> <th>Starting F.Bus</th> <th>Ending To Bus</th> <th>Line impedance</th> <th>Line charging admittance</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>2</td> <td>0.25+j0.8</td> <td>j0.02</td> </tr> <tr> <td>2</td> <td>3</td> <td>0.35+j0.9</td> <td>j0.03</td> </tr> <tr> <td>2</td> <td>4</td> <td>0.25+j1.0</td> <td>j0.04</td> </tr> <tr> <td>3</td> <td>4</td> <td>0.25+j0.8</td> <td>j0.02</td> </tr> <tr> <td>1</td> <td>3</td> <td>0.15+j0.4</td> <td>j0.01</td> </tr> </tbody> </table> <p>Draw the network and find admittance matrix</p>	Starting F.Bus	Ending To Bus	Line impedance	Line charging admittance	1	2	0.25+j0.8	j0.02	2	3	0.35+j0.9	j0.03	2	4	0.25+j1.0	j0.04	3	4	0.25+j0.8	j0.02	1	3	0.15+j0.4	j0.01	CO 1	BT-5	Evaluate						
Starting F.Bus	Ending To Bus	Line impedance	Line charging admittance																															
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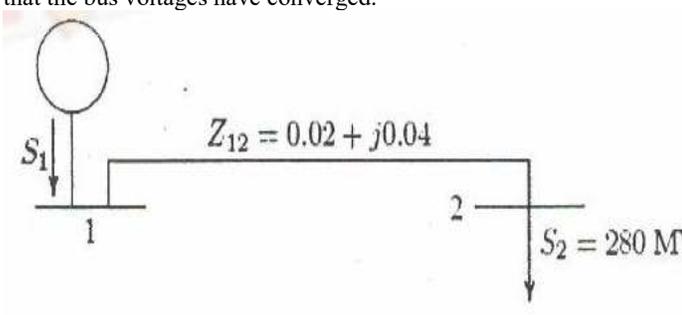
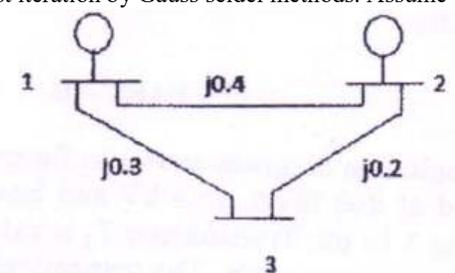
16	<p>Estimate the Ybus for the given network:</p> <table border="1"> <thead> <tr> <th>Element</th> <th>Positive sequence reactance</th> </tr> </thead> <tbody> <tr> <td>1-2</td> <td><math>j1.0</math></td> </tr> <tr> <td>2-3</td> <td><math>j0.4</math></td> </tr> <tr> <td>2-4</td> <td><math>j0.2</math></td> </tr> <tr> <td>3-4</td> <td><math>j0.2</math></td> </tr> <tr> <td>3-1</td> <td><math>j0.8</math></td> </tr> <tr> <td>4-5</td> <td><math>j0.08</math></td> </tr> </tbody> </table>	Element	Positive sequence reactance	1-2	$j1.0$	2-3	$j0.4$	2-4	$j0.2$	3-4	$j0.2$	3-1	$j0.8$	4-5	$j0.08$	CO 1	BT-4	Analyze	
Element	Positive sequence reactance																		
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17	<p>Form Y bus of the test system shown in figure using singular transformation method. The impedance data is given in Table Take (1) as reference node</p>  <table border="1"> <thead> <tr> <th>Element No</th> <th>Bus code</th> <th>Impedance</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>1-2</td> <td>0.5</td> </tr> <tr> <td>2</td> <td>1-3</td> <td>0.6</td> </tr> <tr> <td>3</td> <td>3-4</td> <td>0.4</td> </tr> <tr> <td>4</td> <td>2-4</td> <td>0.3</td> </tr> </tbody> </table>	Element No	Bus code	Impedance	1	1-2	0.5	2	1-3	0.6	3	3-4	0.4	4	2-4	0.3	CO 1	BT-3	Apply
Element No	Bus code	Impedance																	
1	1-2	0.5																	
2	1-3	0.6																	
3	3-4	0.4																	
4	2-4	0.3																	

UNIT II- POWER FLOW ANALYSIS				
PART - A (2 Marks)				
Q.No	Questions	Course Outcome	BT Level	Competence
1	What is the information that are obtained from a load flow study	CO 2	BT-1	Remember
2	What is the need for slack bus in power flow analysis	CO 2	BT-4	Analyze
3	When will the generator bus is treated as load bus	CO 2	BT-2	Understand
4	Extend the acceleration factor in Gauss Seidel Method	CO 2	BT-5	Evaluate
5	Prepare the advantages and disadvantages of Gauss Seidel method	CO 2	BT-3	Apply
6	What is the need for load flow analysis	CO 2	BT-1	Remember
7	Associate with load flow studies are important for planning the existing system as well as the future expansion	CO 2	BT-2	Understand
8	When the generator bus is treated as a load bus in NR load flow study? What will be the reactive power and bus voltage when the generator bus is treated as a load bus?	CO 2	BT-3	Apply

9	Show the general power flow equation.	CO 2	BT-4	Analyze
10	What is a swing bus?	CO 2	BT-1	Remember
11	Compare GSM and NRM with respect to number of iterations taken for convergence and memory requirement	CO 2	BT-4	Analyze
12	Discuss the effect of acceleration factor in the load flow solution algorithm	CO 2	BT-2	Understand
13	What are the disadvantage NR method	CO 2	BT-3	Apply
14	Define Acceleration Value..	CO 2	BT-1	Remember
15	Compare GS and NR methods.	CO 2	BT-5	Evaluate
16	Explain what do you mean by flat voltage start	CO 2	BT-6	Create
17	Mentioned the various types of buses in power system with specified quantities for each bus	CO 2	BT-1	Remember
18	Mentioned the various types of buses in power system with specified quantities for each bus	CO 2	BT-6	Create
19	What is Jacobian matrix	CO 2	BT-2	Understand
20	Define voltage-controlled bus and load bus	CO 2	BT-1	Remember
21	Explain bus classification in power flow analysis with their known and unknown quantities?	CO 2	BT-3	Apply
22	Show the power balance equation.	CO 2	BT-1	Remember
23	Describe how the convergence of Newton Raphson method is speeded up.	CO 2	BT-5	Evaluate
24	Recommend the necessity of a slack bus?	CO 2	BT-6	Create
<b>PART - B (16 Marks)</b>				
1	Prepare the load flow algorithm using Gauss Seidel method with flowchart and discuss the advantages of the method.	CO 2	BT-1	Remember
2	Formulate the load flow equations using Ybus matrix and Explain the computational procedure for load flow by Gauss Seidel method.	CO 2	BT-5	Evaluate
3	Derive N-R method of load flow algorithm and explain the implementation of this algorithm with the flowchart.	CO 2	BT-2	Understand
4	Formulate the load flow equations using Ybus matrix and Explain the computational procedure for load flow by Newton Raphson method.	CO 2	BT-5	Evaluate

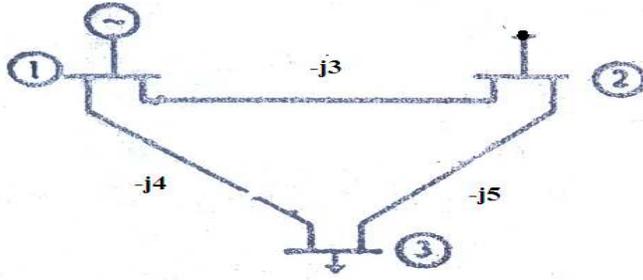
5	<p>For the sample system shown in the fig. The generators are connected at all four buses while the loads are at buses 2 and 3. Assuming a flat voltage start, examine bus voltages and bus angles at the end of first Gauss seidel iterations and consider the reactive power limits <math>0.2 \leq Q_2 \leq 1</math>.</p> <table border="1" data-bbox="293 296 914 615"> <thead> <tr> <th>Bus</th> <th>P in pu</th> <th>Q in pu</th> <th>V in pu</th> <th>Remarks</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>-</td> <td>-</td> <td>1.04∠0°</td> <td>Slack bus</td> </tr> <tr> <td>2</td> <td>0.5</td> <td>-</td> <td>1.04 pu</td> <td>PV bus</td> </tr> <tr> <td>3</td> <td>-1.0</td> <td>0.5</td> <td>-</td> <td>PQ bus</td> </tr> <tr> <td>4</td> <td>0.3</td> <td>-0.1</td> <td>-</td> <td>PQ bus</td> </tr> </tbody> </table> 	Bus	P in pu	Q in pu	V in pu	Remarks	1	-	-	1.04∠0°	Slack bus	2	0.5	-	1.04 pu	PV bus	3	-1.0	0.5	-	PQ bus	4	0.3	-0.1	-	PQ bus	CO 2	BT-3	Apply
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9	<p>The Figure shows the one line diagram of a simple 3 bus system with generation at buses 1 and 3. Line impedances are marked in p.u on a 100 MVA base. Determine the bus voltages at the end of second iteration using Gauss seidel method</p> 	CO 2	BT-3	Apply												

10	<p>In the power system network shown in figure, bus 1 is a slack bus with <math>V_1 = 1.0 + j0.0</math> per unit and bus 2 is a load bus with <math>S_2 = 280 \text{ MW} = j60 \text{ MVAR}</math>. The line impedance on a base of 100MVA is <math>Z = 0.02 + j0.04</math> per unit. Using Gauss – Seidel method, give <math>V_2</math>. Use an initial estimate of <math>V_2^{(0)} = 1.0 + j0.0</math> and perform four iterations. Also find <math>S_1</math> and the real, reactive power loss in the line, assuming that the bus voltages have converged.</p> 	CO 2	BT-6	Create																																				
11	<p>The system data for a load flow problem are given in table. Solve bus voltages at the end of first iteration by G-S method by taking <math>\alpha = 1.6</math>.</p> <table border="1" data-bbox="321 751 868 903"> <thead> <tr> <th>Line no</th> <th>Bus code</th> <th>Admittance in p.u.</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>1-2</td> <td><math>2-j8</math></td> </tr> <tr> <td>2</td> <td>1-3</td> <td><math>1-j4</math></td> </tr> <tr> <td>3</td> <td>2-3</td> <td><math>0.6-j2.6</math></td> </tr> </tbody> </table>	Line no	Bus code	Admittance in p.u.	1	1-2	$2-j8$	2	1-3	$1-j4$	3	2-3	$0.6-j2.6$	CO 2	BT-3	Apply																								
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Bus No.	Voltage			Generator		Load				$Q_{\min}$ MVAR	$Q_{\max}$ MVAR																													
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13

A three bus power system is shown in figure. The relevant per unit line admittance on 100 MVA base are indicated on the diagram and bus data are given in table. Form  $Y_{bus}$  and Give the voltage at bus 2 and bus 3 after first iteration using gauss seidel method. Take the acceleration factor  $\alpha=1.6$ .



Bus Number	Type	Generation		Load		Bus voltage	
		$P_G$ (MW)	$Q_G$ (MVAR)	$P_G$ (MW)	$Q_G$ (MVAR)	V(p.u)	$\delta$ deg
1	Slack	-	-	0	0	1.02	0
2	PQ	25	15	50	25	-	-
3	PQ	0	0	60	30	-	-

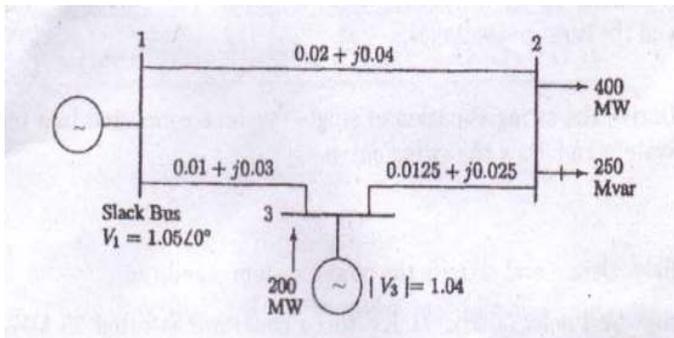
CO 2

BT-5

Evaluate

14

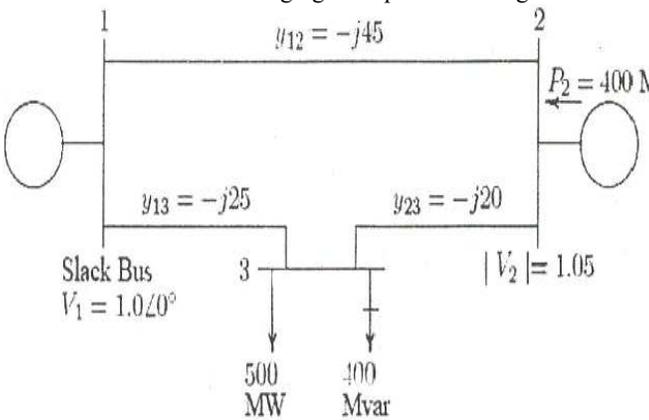
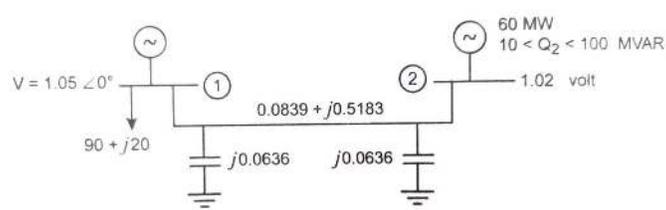
Evaluate the Jacobian elements for the 3-bus system shown in figure. All the impedance in this figure are mentioned in p,u



CO 2

BT-2

Understand

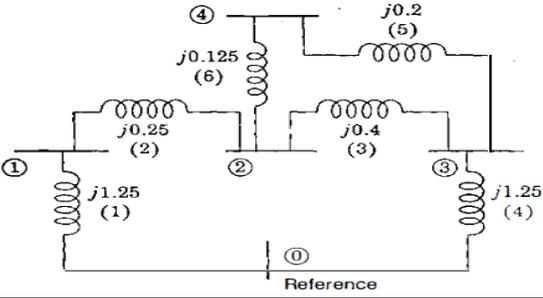
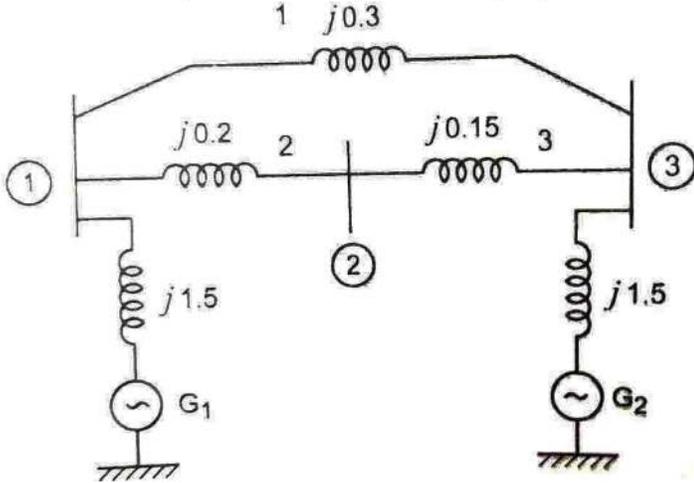
15	<p>Figure shows the one-line diagram of a simple three bus power system with generation at buses at 1 and 2. the voltage at bus 1 is <math>V=1+j0.0</math> V per unit. Voltage magnitude at bus 2 is fixed at 1.05 p.u. with a real power generation of 400 MW. A Load consisting of 500MW and 400 MVAR base. For the purpose of hand calculation, line resistance and line charging susceptance are neglected</p>  <p>Using Newton-Raphson method, start with the initial estimates of <math>V_2^0=1.05+j0.0</math> and <math>V_3^0=1.05+j0.0</math>, and keeping <math> V_2 =1.05</math> p.u., examine the phasor values <math>v_2</math> and <math>v_3</math>. perform a single iteration.</p>	CO 2	BT-5	Evaluate
16	<p>For the system of Fig. find the voltage at the receiving bus at the end of the first iteration. Load is <math>2 + j0.8</math> p.u. Voltage at the sending end (slack) is <math>1 + j0</math> p.u. Line admittance is <math>1.0 - j4.0</math> p.u. Transformer reactance is <math>j0.4</math> p.u. Off-nominal turns ratio is <math>1/1.04</math>. Use the GS technique. Assume <math>VR= 1\angle 0^\circ</math></p> 	CO 2	BT-4	Analyze
17	<p>Using Gauss Seidel method examines bus voltages for the fig shown. Take base MVA as 100, <math>\alpha=1.1</math>.</p> 	CO 2	BT-3	Apply

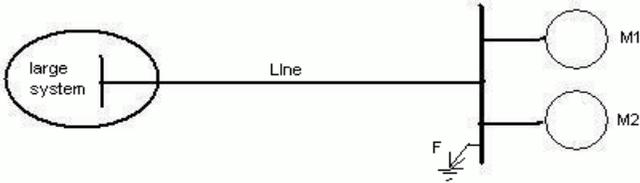
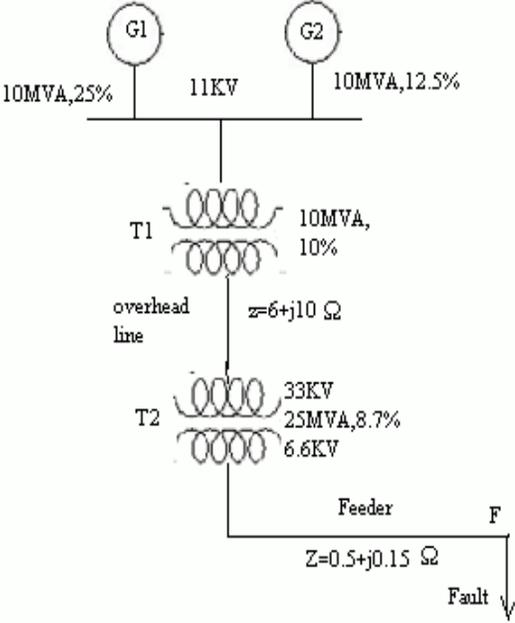
### UNIT III SYMMETRICAL FAULT ANALYSIS

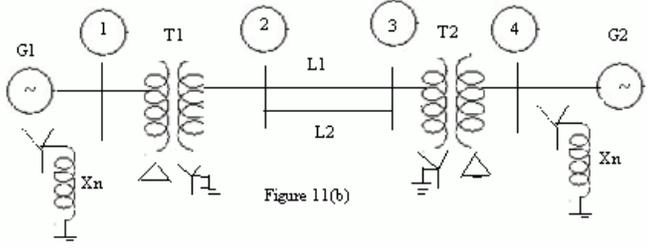
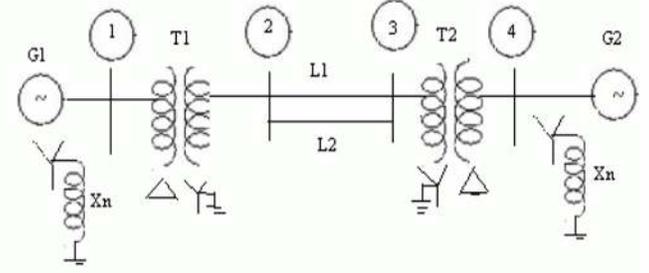
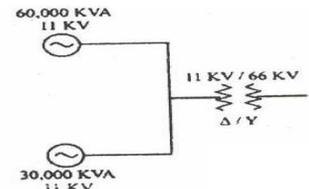
#### PART - A (2 Marks)

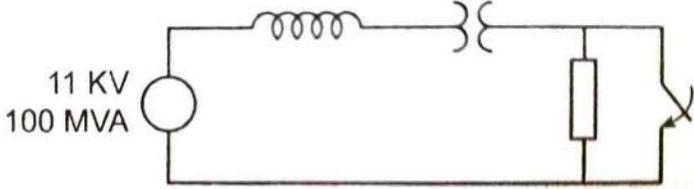
Q.No	Questions	Course Outcome	BT Level	Competence
1	Write the ways of adding an impedance to an existing system to modify bus impedance matrix	CO 3	BT-4	Analyze
2	Define short circuit capacity of power system	CO 3	BT-1	Remember
3	Show the oscillation of short circuit current when an unloaded generator is subjected to a symmetrical fault clearly marking sub-transient, transient and steady state regions	CO 3	BT-3	Apply
4	Discuss the prefault currents are usually neglected in fault computation?	CO 3	BT-4	Analyze
5	What is meant by fault calculations	CO 3	BT-2	Understand
6	What is meant by symmetrical fault	CO 3	BT-5	Evaluate
7	Distinguish between symmetrical and unsymmetrical short circuits.	CO 3	BT-5	Evaluate
8	Define a bolted fault?	CO 3	BT-1	Remember
9	Why the Z bus method is very suitable for fault studies on large systems.	CO 3	BT-4	Analyze
10	Summarize two approximations made in short circuit studies	CO 3	BT-1	Remember
11	How do short circuits occur in power systems and summarize two objectives of short circuit analysis?	CO 3	BT-3	Apply
12	Discover the main differences in representation of power systems for load flow and short circuit studies.	CO 3	BT-2	Understand
13	Compose, what is meant by the doubling effect?	CO 3	BT-2	Understand
14	Explain the need for fault analysis in the power system?	CO 3	BT-6	Create
15	Explain the sub transient reactance and transient reactance?	CO 3	BT-1	Remember
16	Summarize the reason for transients during a short circuit?	CO 3	BT-6	Create
17	State and explain symmetrical fault	CO 3	BT-3	Apply
18	Define synchronous reactance, transient reactance, sub transient reactance	CO 3	BT-1	Remember
19	Define fault level.	CO 3	BT-1	Remember
20	Summarize the applications of short circuit analysis	CO 3	BT-2	Understand
21	Can feeder reactors permit the use of circuit breakers of lower ratings?	CO 3	BT-1	Remember
22	Will the value of short-circuit current change if we take different base kVAs? Explain your answer.	CO 3	BT-6	Create
23	What is the advantage of expressing reactances in percentage values?	CO 3	BT-3	Apply
24	Explain the harmful effects of short-circuit faults on the power system.	CO 3	BT-1	Remember

**PART - B (16 Marks)**

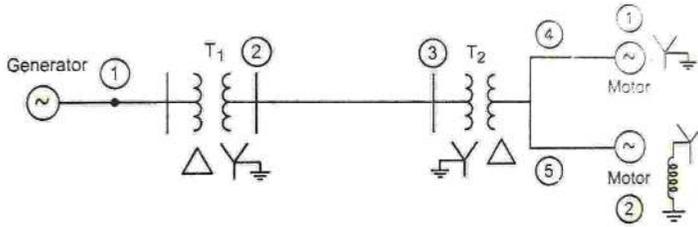
1	Explain the step-by-step procedure to find the fault current of three phase symmetrical fault by using thevenin's theorem.	CO 3	BT-1	Remember
2	<p>Examine the bus impedance matrix using a bus building algorithm for the given network.</p> 	CO 3	BT-2	Understand
3	<p>Determine Bus Impedance matrix by Bus Building Algorithm.</p> 	CO 3	BT-3	Apply
4	Explain the step-by-step procedure for systematic fault analysis for a three-phase fault using bus impedance matrix.	CO 3	BT-1	Remember
5	<p>A 3 phase 5 MVA, 6.6 kV alternator with a reactance of 8% is connected to a feeder series impedance <math>(0.12+j0.48)</math> ohm/phase/km through a step-up transformer. The transformer is rated at 3 MVA, 6.6 kV/33kV and has a reactance of 5%. Determine the fault current supplied by the generator operating under no load with a voltage of 6.9 kV, when a 3 phases symmetrical fault occurs at a point 15 km along the feeder.</p>	CO 3	BT-2	Understand

6	<p>Two synchronous motors are connected to the bus of the large system through a short transmission line shown in fig. The rating of the various components is given.  MOTOR (each): 1 MVA, 440V, 0.1 p.u.  Transient reactance line: <math>0.05\Omega</math> (reactance)  Large system: Short circuit MVA at its bus at 440V is 8  When the motor is operating at 400V, examine the short circuit current (symmetrical) fed into a three-phase fault at the motor bus.</p> 	CO 3	BT-5	Evaluate
7	<p>For the radial network shown in figure, a 3-phase fault occurs at point F. examine the fault current.</p> 	CO 3	BT-4	Analyze
8	<p>A 3-phase 5 MVA, 6.6 KV alternator with a reactance of 8% is connected to a feeder of series impedance <math>(0.12+j0.48)</math> ohm/phase/km through a step-up transformer. The transformer is rated at 3 MVA, 6.6 kV/33kV and has a reactance of 5%. Calculate the fault current supplied by the generator operating under no load with a voltage of 6.9 KV when a three-phase symmetrical fault occurs at a point 15 km along the feeder.</p>	CO 3	BT-3	Apply
9	<p>A 3-phase, 30 MVA, 33 kV alternator has internal reactance of 4% and negligible resistance. Find the external reactance per phase to be connected in series with the alternator so that steady current on short circuit does not exceed 10 times the full load current.</p>	CO 3	BT-5	Evaluate

10	<p>A symmetrical fault occurs on bus 4 of system shown in figure; examine the fault current, post fault voltages, line flows. Generator <math>G_1, G_2</math>: 100 MVA, 20 kV, <math>X^+ = 15\%</math>. Transformer <math>T_1, T_2</math>: <math>X_{leak} = 9\%</math>, Transmission line <math>L_1, L_2</math>: <math>X^+ = 10\%</math></p>  <p style="text-align: center;">Figure 11(b)</p>	CO 3	BT-1	Remember
11	 <p>A symmetrical fault occurs on bus 4 of the system through <math>Z_f = j0.14</math> pu in figure. Using bus building algorithms, calculate the fault current, post fault voltages, line flows.</p> <p><math>G_1, G_2</math>: 100 MVA, 20kV, <math>X^+ = 15\%</math>  Transformer <math>T_1, T_2</math>: <math>X_{leak} = 9\%</math>  Transmission line <math>L_1, L_2</math>, <math>X^+ = 10\%</math>.</p>	CO 3	BT-2	Understand
12	<p>Two generators are connected in parallel to the low voltage side of a 3<math>\Phi</math> delta star transformer as shown in figure. Generator 1 is rated 60,000 KVA, 11 kV. Generator 2 is rated 30,000 KVA, 11kV. each generator has a sub transient reactance of <math>X_d'' = 25\%</math>. the transformer is rated 90,000 KVA at 11 kV-delta/66KV star with a reactance of 10%. Before a fault occurred, the voltage on the HT side of the transformer was 63kV. The transformer was unloaded and there is no circulating current between the generators. Calculate the sub transient current in each generator when a three-phase fault occurs on the HT side of the transformer.</p> 	CO 3	BT-5	Evaluate

13	<p>A generator transformer unit is connected to a line circuit breaker the unit rating is:  Generator: 10MVA, 6.6kV; <math>X_d''=0.1</math> p.u, <math>X_d'=0.2</math> p.u and <math>X_d=0.8</math> p.u  Transformer: 10mva, 6.9/33kV, <math>X=0.08</math> p.u,  The system is operating on no load at a line voltage of 30 kV, when a 3<math>\Phi</math> fault occurs on the line just beyond the circuit breaker. Solve  (i) The initial symmetrical rms current in the breaker.  (ii) The maximum possible dc offset current in the breaker.  (iii) the momentary current rating of the breaker  (iv) the current to be interrupted by the breaker and the interrupting kVA  (V) The sustained short circuit current in the breaker.</p>	CO 3	BT-4	Analyze
14	<p>A generating station has four bus-bar sections. Each section is connected to a tie-bar through 20% reactors rated at 200 MVA. Generators of total capacity 100 MVA and 20% reactance are connected to each busbar section. Calculate the MVA fed to a fault under short-circuit condition one of the bus-bars.</p>	CO 3	BT-4	Analyze
15	<p>A 100 MVA, 11 KV, 50 Hz, star-connected, three phase synchronous generator is connected to a 11/220KV, 100 MVA, <math>\Delta</math>-Y connected transformer. The reactances are per unit on the same base.  Reactance of the generator: <math>X_d = 0.9</math> p.u; <math>X_d' = 0.2</math> p.u.; <math>X_d'' = 0.1</math> p.u.  Reactance of the transformer is 0.2p.u.  A three phase load of 100 MVA, 0.8 p.f. lagging is connected to the transformer secondary side as shown in Fig. The line-to-line voltage at the load terminals is 220 KV. A 3 phase short circuit occurs at the load terminals. Find the generator transient current including the load current.</p> 	CO 3	BT-4	Analyze
16	<p>A 3-phase transmission line operating at 33kV and having resistance of <math>5 \Omega</math> and reactance of <math>20\Omega</math> is connected to the generating station through 15,000 KVA step up transformers. Connected to the bus bar are two alternators one of 10,000KVA with 10% reactance and another of 5000 KVA with 7.5% reactance. Draw the single line diagram and calculate the short circuit KVA for symmetrical fault between phases at the load end of the transmission line</p>	CO 3	BT-5	Evaluate

17	<p>A 25 MVA, 11 KV, 3 phase generator has a subtransient reactance of 20%. The generator supplies two motors over a transmission line with transformers at both ends as shown in Fig. The motors have rated input of 15 and 7.5 MVA, both 10 KV and 20% subtransient reactance. The 3 phase transformers are both rated 50 MVA, 10.8/121 KV with <math>\Delta</math>-Y connection with leakage reactance of 10% each. The series reactance of the line is <math>80 \Omega</math> Draw the impedance diagram of the system with reactances marked in p.u. when symmetrical fault occurs at bus 2 and calculate fault current.</p>	CO 3	BT-5	Evaluate
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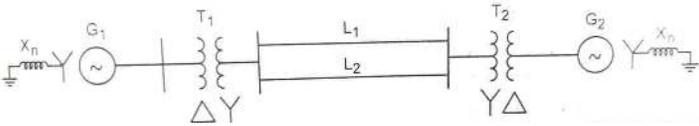
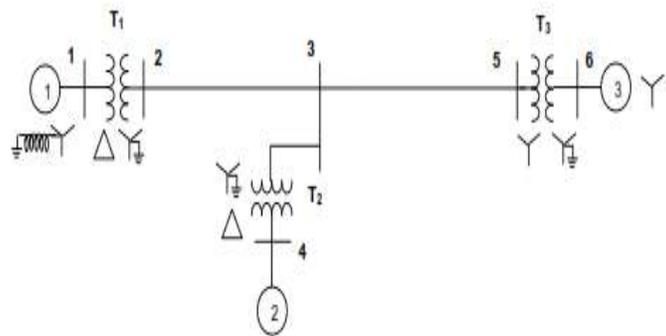


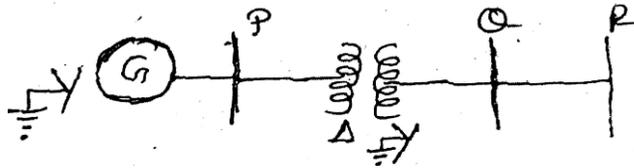
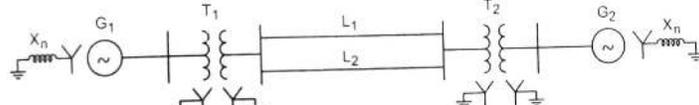
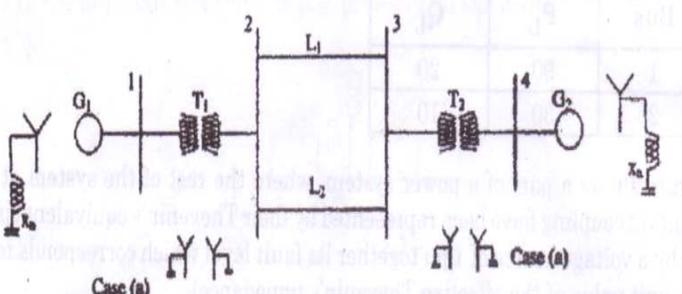
**UNIT IV UNSYMMETRICAL FAULT ANALYSIS**

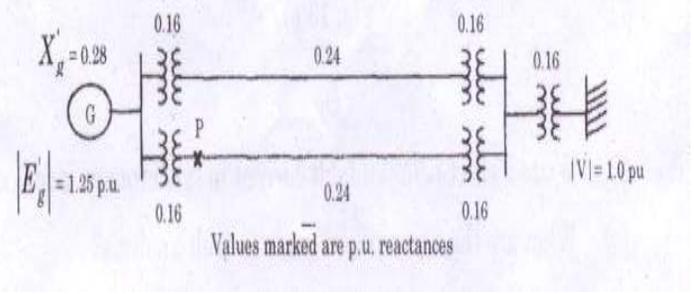
**PART - A (2 Marks)**

<b>Q.No</b>	<b>Questions</b>	<b>Course Outcome</b>	<b>BT Level</b>	<b>Competence</b>
1	Name the faults which are having all three equal sequence current and which do not have zero sequence current	CO 4	BT-1	Remember
2	Why the neutral grounding impedance $Z_n$ appears as $3Z_n$ in zero sequence equivalent circuit	CO 4	BT-2	Understand
3	Point out the sequence network diagram for line-to-line fault with fault impedance	CO 4	BT-5	Evaluate
4	Evaluate the sequence network diagram for line to ground with fault impedance	CO 4	BT-3	Apply
5	Explain the significance of sub transient reactance and transient reactance in short circuit studies	CO 4	BT-2	Understand
6	Write boundary conditions for single line to ground faults	CO 4	BT-1	Remember
7	Describe the symmetrical components of the phase 'a' current in terms of positive, negative, and zero-sequence components.	CO 4	BT-4	Analyze
8	Describe the equation for sub transient and transient internal voltage of the motor	CO 4	BT-3	Apply
9	Define doubling effect and DC off-set current	CO 4	BT-1	Remember
10	Summarize different between sub transient and transient reactance			
11	Explain the features of zero sequence current?	CO 4	BT-3	Apply
12	Discuss the symmetrical components of three phase system	CO 4	BT-5	Evaluate
13	Define negative sequence and zero sequence components	CO 4	BT-1	Remember
14	Define short circuit capacity	CO 4	BT-1	Remember
15	Discover the symmetrical components $V_{a1}$ , $V_{a2}$ and $V_{a0}$ in terms of unbalanced vectors $V_a$ , $V_b$ and $V_c$ .	CO 4	BT-4	Analyze
16	Write down the equation determine symmetrical currents for unbalanced current	CO 4	BT-6	Create
17	What are symmetrical components	CO 4	BT-2	Understand
18	Demonstrate the zero-sequence network diagram of a delta-delta connected transformer.	CO 4	BT-4	Analyze
19	In which fault, the negative and zero sequence currents are absent? Discuss	CO 4	BT-6	Create
20	Develop the connection of sequence networks for line –to-line fault without fault impedance.	CO 4	BT-2	Understand
21	Why do we prefer to analyse unsymmetrical faults by symmetrical components method?	CO 4	BT-6	Create
22	Express unbalanced phase currents in a 3- $\phi$ system in terms of symmetrical component	CO 4	BT-2	Understand
23	Why is a 3- $\phi$ symmetrical fault more severe than a 3- $\phi$ unsymmetrical fault?	CO 4	BT-4	Analyze

24	In a 3- $\phi$ system, it has been found that negative sequence components and zero sequence components are absent. What do you conclude from it?	CO 4	BT-6	Create
<b>PART – B (16 Marks)</b>				
1	Explain the concept of symmetrical component is used short circuit studies in the power system	CO4	BT-3	Apply
2	Examine the sequence impedances of synchronous machines, transmission lines, and star-connected loads using a suitable example.	CO 4	BT-5	Evaluate
3	Examine the sequence network for a double line to ground (LLG) fault.	CO 4	BT-2	Understand
4	Discuss the expression for fault current in a single line to ground fault and draw an equivalent network.	CO 4	BT-1	Remember
5	Show the expression for fault current in line-to-line fault and draw an equivalent network.	CO 4	BT-2	Understand
6	Point out the expression for fault current for a line-to-line fault taken place through impedance $Z_b$ in a power system.	CO 4	BT-2	Understand
7	A 25MVA, 11KV, three phase generator has a sub transient reactance of 20%. The generator supplies two motors over a transmission line with transformers at both ends as shown in one line diagram of figure. The motors have rated inputs of 15 and 7.5 MVA both 10KV with 25% sub transient reactance. The three phase transformers are rated 30MVA, 10.8/121KV, and connection delta-star with leakage reactance of 10% each. The series reactance of the line is 100 ohms. Label the positive and negative sequence networks of the system with reactance marked in per unit.	CO 4	BT-6	Create
8	A salient pole generator without dampers is rated 20 MVA, 13.6 KV and has direct axis sub – transient reactance of 0.2 per unit. The negative and zero sequence reactances are, respectively, 0.35 and 0.1 per unit. The neutral of the generator is solidly grounded. With the generator operating unloaded at rated voltage with $E_{an}=1.0 \angle 0^\circ$ per unit, a single line to ground fault occurs at the machine terminals, which then have per -unit voltage to ground, $V_a = 0$ ; $V_b = 1.013 \angle -102.25^\circ$ ; $V_c = 1.013 \angle 102.25^\circ$ Give the sub transient current in the generator and the line to line voltage for sub transient conditions due to the fault.	CO 4	BT-3	Apply
9	Determine the fault current in p.u., current in phase domain form for a double line to ground fault occurs between phases ‘b’ and ‘c’ at bus 4 as shown in Fig. $G_1, G_2 : 100 \text{ MVA}, 11 \text{ kV}, X^+ = X^- = 15\%, X^0 = 5\%, X_n = 6\%$ . $T_1, T_2 : 100 \text{ MVA}, 11/220 \text{ kV}, X_{\text{leak}} = 9\%$ . $L_1, L_2 : X^+ = X^- = 10\%, X^0 = 10\%$ on a base of 100 MVA.	CO 4	BT-3	Apply

10	<p>A Double Line to Ground fault occurs on line b and c at point F in the system of figure. Point out the sub transient current in phase c of machine 1. assuming pre fault current to be zero. Both machines are rated 1200 KVA, 600 V with reactance of <math>X''=X_2=10\%</math> AND <math>X_0=5\%</math>. each three phase transformer is rated 1200KVA,600V-delta/300V-star with leakage reactance of 5%.the reactance of the transmission line is <math>X_1=X_2=20\%</math> and <math>X_0=40\%</math> on the base of 1200 KVA, 3300V.the reactance of the neutral of the grounding reactors are 5% on the KVA base of the machines.</p> 	CO 4	BT-3	Apply
11	<p>Determine the fault current in p.u., current in phase domain form for a double line to ground fault occurs between phases 'b' and 'c' at bus 4 as shown in Fig.  <math>G_1, G_2 : 100 \text{ MVA}, 11 \text{ kV}, X^+ = X^- = 15\%, X^0 = 5\%, X_n = 6\%</math>.  <math>T_1, T_2 : 100 \text{ MVA}, 11/220 \text{ kV}, X_{\text{leak}} = 9\%</math>.  <math>L_1, L_2 : X^+ = X^- = 10\%, X^0 = 10\%</math> on a base of 100 MVA.</p> 	CO 4	BT-4	Analyze
12	<p>. The one-line diagram of a power system is shown below.</p>  <p>The following are the p.u. reactances of different elements on a common base</p> <p>Generator 1: <math>X_{g0} = 0.075; X_n = 0.075; X_1 = X_2 = 0.25</math>  Generator 2: <math>X_{g0} = 0.15; X_n = 0.15; X_1 = X_2 = 0.2</math>  Generator 3: <math>X_{g0} = 0.072; X_1 = X_2 = 0.15</math>  Transformer 1: <math>X_0 = X_1 = X_2 = 0.12</math>  Transformer 2: <math>X_0 = X_1 = X_2 = 0.24</math>  Transformer 3: <math>X_0 = X_1 = X_2 = 0.1276</math>  Transmission line 2 – 3 <math>X_0 = 0.5671; X_1 = X_2 = 0.18</math>  Transmission line 3 – 5 <math>X_0 = 0.4764; X_1 = X_2 = 0.12</math>  Prepare the three sequence networks and determine reactants <math>Z_{\text{bus}0}, Z_{\text{bus}1}, Z_{\text{bus}2}</math></p>	CO 4	BT-4	Analyze

13	<p>A 50 Hz 50 MVA, 13.2kV star grounded alternator is connected to a line through a <math>\Delta</math>-Y transformer as shown in figure. The positive, negative, zero sequence impedance of the alternator are <math>j0.1, j0.1, j0.05</math> respectively. The transformer rated at 13.2 kV <math>\Delta</math> /120kV Y, 50Hz with Y solidly grounded has the sequence impedance <math>X''=X_2=X_0=j0.1</math>p.u. The line impedance between Q and R are <math>X_1''=j0.03, X_2=j0.03, X_0=j0.09</math>. Assuming that the fault to be takes place at Q, determine the sub transient fault for a (i) 3 phase fault (ii) L-G fault (iii) L-L-G fault. Draw the connection diagram for the sequence diagram in each fault</p> 	CO 4	BT-5	Evaluate
14	<p>Determine the fault current and fault MVA for a line to line fault that occurs between phases 'b' and 'c' at bus 4 as shown in Fig.  <math>G_1, G_2 : 100 \text{ MVA}, 20 \text{ kV}, X^+ = X^- = 15\%, X^0 = 4\%, X_n = 6\%</math>.  <math>T_1, T_2 : 100 \text{ MVA}, 20/345 \text{ kV}, X_{\text{leak}} = 9\%</math>.  <math>L_1, L_2 : X^+ = X^- = 10\%, X^0 = 40\%</math> on a base of 100 MVA.</p> 	CO 4	BT-5	Evaluate
15	 <p>It is proposed to conduct fault analysis on two alternative configurations of the 4-bus system  <math>G_1, G_2 : 100 \text{ MVA}, 200 \text{ kV}, X^+ = X^- = X_d'' = 20\%, X^0 = 4\%, X_n = 5\%</math>  <math>T_1, T_2 : 100 \text{ MVA}, 20 \text{ kV} / 345 \text{ kV}, X_{\text{leak}} = 8\%</math>  <math>L_1, L_2 : X^+ = X^- = 15\%; X^0 = 50\%</math> on a base of 100 MVA  For a three phase to ground (solid) fault at bus 4, determine the fault current and MVA at faulted bus, post fault bus voltages, fault current distribution in different elements of the network using Thevenin equivalent circuit. Draw a single line diagram showing the above results</p>	CO 4	BT-5	Evaluate

16	<p>In the power system shown in figure three phase fault occurs at point P and the faulty line was opened a little late. Find the power output equations for the pre-fault during fault and post fault calculation</p>  <p>Values marked are p.u. reactances</p>	CO 4	BT-4	Analyze
17	<p>Two Synchronous machines are connected through three-phase transformers to the transmission line as given in Fig. The ratings and reactances of the machines and transformers are:  Machines  Machines 1 and 2: 100 MVA; 20kV; <math>X_d''=X_1=X_2=20\%</math>; <math>X_0=4\%</math>; <math>X_n=5\%</math>.  Transformers <math>T_1</math> and <math>T_2</math>: 100 MVA; 20 Y/345 Y kV; <math>X=8\%</math>.  Both transformers are solidly grounded on two sides on a chosen base of 100 MVA, 345 kV in the transmission line circuit. The line reactances are <math>X_1 = X_2 = 15\%</math> and <math>X_0=50\%</math>. The system is operating at nominal voltage without pre fault currents when a bolted (<math>Z_f = 0</math>) single line-to-ground fault occurs on phase 'a' at bus 3. Determine the subtransient current to ground at the fault.</p> 	CO 4	BT-3	Apply

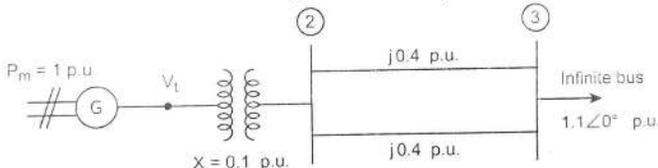
### UNIT V -STABILITY ANALYSIS

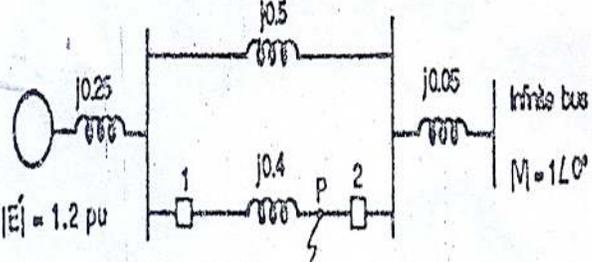
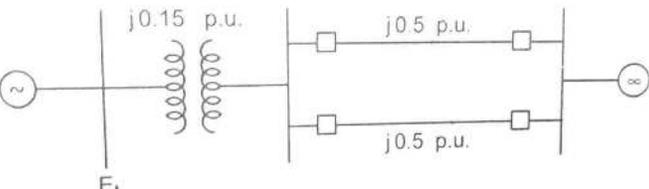
#### PART - A (2 Marks)

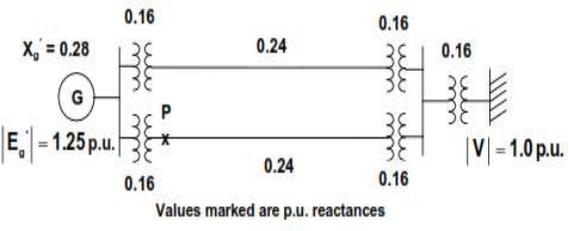
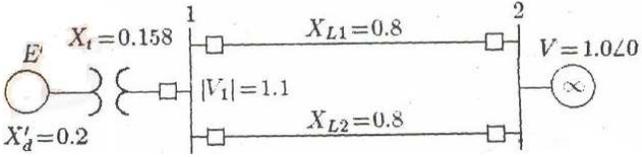
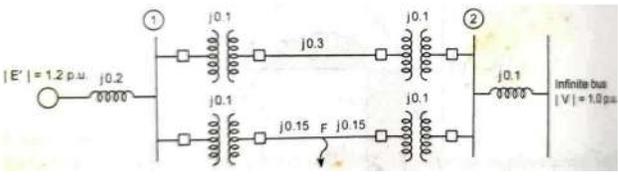
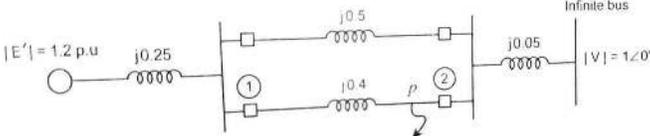
Q.No	Questions	Course Outcome	BT Level	Competence
1	A four pole, 60HZ synchronous generator has a rating of 200 MVA, 0.8 power factor lagging. The moment of inertia of the rotor is 45100 kg-m <sup>2</sup> . formulate M and H	CO 5	BT-6	Create
2	Define stability.	CO 5	BT-1	Remember
3	Infer the significance of critical clearing time	CO 5	BT-4	Analyze
4	Discuss transient stability.	CO 5	BT-2	Understand

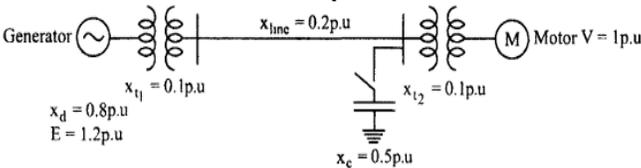
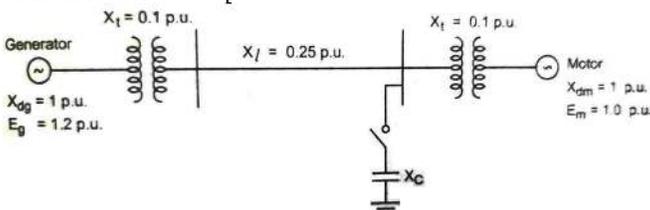
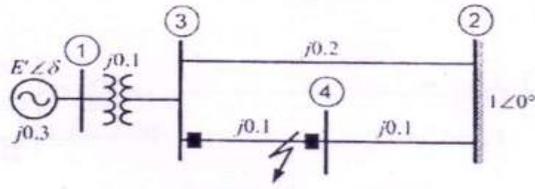
5	Summarize assumptions upon transient stability	CO 5	BT-4	Analyze		
6	Define steady state stability limit?	CO 5	BT-1	Remember		
7	How to improve the transient stability limit of the power system	CO 5	BT-3	Apply		
8	Examine how to improve the transient stability limit of the power system?	CO 5	BT-5	Evaluate		
9	Classify steady state stability limit. Define them	CO 5	BT-2	Understand		
10	Discover the machine problems seen in the stability study	CO 5	BT-3	Apply		
11	Give the expression for the swing equation. Explain each term along with their units.	CO 5	BT-1	Remember		
12	Order the assumptions made in solving the swing equation?	CO 5	BT-2	Understand		
13	Define swing curve. What is the use of a swing curve?	CO 5	BT-1	Remember		
14	Point out the control schemes included in stability control techniques?	CO 5	BT-3	Apply		
15	What are coherent machines	CO 5	BT-4	Analyze		
16	Point out equal area criterion	CO 5	BT-1	Remember		
17	Give the expression for critical clearing time	CO 5	BT-6	Create		
18	List the types of disturbances that may occur in a single machine infinite bus bar system of the equal area criterion stability	CO 5	BT-5	Evaluate		
19	Define critical clearing angle.	CO 5	BT-1	Remember		
20	List the assumptions made in multi machine stability studies	CO 5	BT-2	Understand		
21	Define rotor angle stability. List out two categories of rotor angle stability.	CO 5	BT-1	Remember		
22	What are the methods used to determine the control or small signal oscillation interaction?	CO 5	BT-6	Create		
23	Discuss why? the use of automatic enclosing circuit breakers improve system stability.	CO 5	BT-5	Evaluate		
24	On what basis can we conclude that synchronous generator goes out of stability?	CO 5	BT-4	Analyze		

**PART - B (16 Marks)**

1	Examine swing equations used for stability studies in the power system.	CO 5	BT-1	Remember		
2	Describe the equal area criterion for transient stability analysis of a system	CO 5	BT-4	Analyze		
3	<p>The generator shown in Fig, is delivering power to an infinite bus. Take <math> V_t =1.1</math> p.u. and <math>X_d=0.2</math> p.u. Find the maximum power that can be transferred when the system is healthy.</p> 	CO 5	BT-4	Analyze		

4	<p>Given the system of figure below where a three-phase fault is applied at a point P as shown.</p>  <p>Examine the critical clearing angle for clearing the fault with simultaneous opening of the breakers 1 and 2. The reactance values of various components are indicated on the diagram. The generator is delivering 1.0 p.u power at the instant preceding the fault. The fault occurs at point P as shown in above figure.</p>	CO 5	BT-2	Understand	
5	<p>The Single Line diagram of Fig. shows a generator connected through parallel transmission lines to a larger metropolitan system considered as an infinite bus. The machine is delivering 0.9 p.u. power, 0.8 p.f. lagging, <math>E_f=1.0</math> p.u. The transient reactance of the generator is 0.3 p.u. Determine (a) the power angle equation for the given system. (b) Draw power angle curve (c) Swing equation.</p> 	CO 5	BT-4	Analyze	
6	<p>A 50 Hz, 500 MVA, 400 KV generator (with transformer) is connected to a 400 KV infinite bus bar through an interconnector. The generator has <math>H = 2.5</math> MJ/MVA, Voltage behind transient reactance of 450 KV and is loaded 460 MW. The transfer reactances between generator and bus bar under various conditions are:  Prefault 0.5 Pu  During Fault 1.0 Pu  Post fault 0.75 Pu  Calculate the swing curve using intervals of 0.05 sec and assuming that the fault is cleared at 0.15 sec.</p>	CO 5	BT-5	Evaluate	
7	<p>Explain the modified Euler method of analyzing a multi machine power system for stability, with a neat flow chart.</p>	CO 5	BT-1	Remember	
8	<p>A cylinder rotor generator delivers 0.5 pu power in the steady-state to an infinite bus through a transmission line of reactance 0.5 pu. The generator no-load voltage is 1.5 pu and the infinite bus voltage is 1 pu. The inertia constant of the generator is 5MW-s/MVA and the generator reactance is 1 pu. The critical clearing angle, in degrees, for a three-phase dead short circuit fault at the generator terminal is</p>	CO 5	BT-2	Understand	

9	<p>In the power system shown in Fig three phase fault occurs at P and the faulty line was opened a little later. Find the power output equations for the pre-fault, during fault and post-fault condition. if delivering 1.0 p.u just before fault occurs, calculate <math>\delta_{cc}</math>.</p>  <p style="text-align: center;">Values marked are p.u. reactances</p>	CO 5	BT-3	Apply	
10	<p>A 60Hz synchronous generator has a transient reactance of 0.2 p.u and an inertia constant of 5.66MJ/MVA. The generator is connected to an infinite bus through a transformer and a double circuit transmission line, as shown in figure. Resistance is neglected and reactance are expressed on a common MVA base and are marked on the diagram. The generator is delivering a real power of 0.77 p.u to bus bar 1. Voltage magnitude at bus 1 is 1.1 p.u. the infinite bus voltage <math>V=1.06\angle 0</math> p.u. evaluate the generator excitation voltage and swing equation.</p> 	CO 5	BT-3	Apply	
11	<p>A 3 phase fault occurs at point F as shown in Fig. Determine the critical clearing angle for the system. The generator is delivering 1.0 p.u. power under pre fault condition.</p> 	CO 5	BT-3	Apply	
12	<p>A generator is operating 50Hz, delivers 1.0 p.u power to an infinite through a transmission circuit in which resistance is ignored. A fault took place reducing a maximum power transferable to 0.5 p.u. Before the fault, this power was 2.0 p.u and after the clearance of the fault it is 1.5p.u. By using equal area criterion, determine the critical clearing angle.</p>	CO 5	BT-1	Remember	
13	<p>A three phase fault is applied at the point P as shown in fig. Find the critical clearing angle for clearing the fault with simultaneous opening of the breakers 1 and 2. The reactance values of various components are indicated in the diagram. The generator is delivering 1.0 p.u. power at the instant preceding the fault.</p> 	CO 5	BT-3	Apply	

14	<p>Power is supplied by a generator to a motor over a transmission line as shown in Fig. To the motor bus a capacitor of 0.8 pu reactance per phase is connected through a switch. Determine the steady state power limit with and without the capacitor in the circuit.</p> 	CO 5	BT-4	Analyze	
15	<p>A four pole synchronous generator rated 110 MVA 12.5 KV, 50 HZ has an inertia constant of 5.5 MJ / MVA</p> <p>(i) Determine the stored energy in the rotor at synchronous speed.</p> <p>(ii) When the generator is supplying a load of 75 MW, the input is increased by 10 MW. Determine the rotor acceleration, neglecting losses.</p> <p>(iii) If the rotor acceleration in (ii) is maintained for 8 cycles, find the change in the torque angle and the rotor speed in rpm at the end of 8 cycles</p>	CO 5	BT-3	Apply	
16	<p>In the system shown in Fig. a three phase static capacitive reactor of reactance 1 p.u. per phase is connected through a switch at the motor bus bar. Calculate the limit of steady state power with and without the reactor switch closed. Recalculate the power limit with a capacitive reactor replaced by an inductive reactor of the same value.</p> <p>Assume the internal voltage of the generator to be 1.2 p.u. and that of the motor to be 1.0 p.u.</p> 	CO 5	BT-3	Apply	
17	<p>The per unit system reactances that are converted to common base are shown in figure. Let us assume that the infinite bus voltage is 10. The generator is delivering 1.0 per unit real power at a lagging power factor of 0.93839 to the infinite bus. While the generator is operating in steady state a three-phase bolted short circuit occurs in the transmission line connecting buses 2 and 4 very near to bus 4. The fault is cleared by opening the circuit breakers at the two ends of this line, finding the critical clearing time for various values of H.</p> 	CO 5	BT-3	Apply	