Code No: RT32024 **R13** SET - 1

III B. Tech II Semester Regular/Supplementary Examinations, April -2018

POWER SYSTEM ANALYSIS

(Electrical and Electronics Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answering the question in **Part-A** is compulsory
3. Answer any **THREE** Questions from **Part-B**

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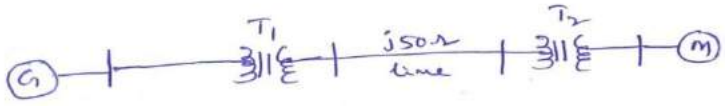
PART –A

1 a) What is the need of single line diagram in power systems? [3M]
b) Derive the static power flow equations. [4M]
c) Why do you need Z_{Bus} for fault analysis than Y_{Bus}. [3M]
d) For a fault at a given location, rank the various faults in the order of severity. [4M]
e) What is the utility of symmetrical components? [4M]
f) Discuss the various methods of improving steady state stability. [4M]

PART -B

2 Draw the reactance diagram for the power system shown in below figure. The ratings as follows: [16M]
Generator: 40MVA, 25 kV, X''=20%
Synchronous motors : 50MVA, 11 kV, X'=30%
Transformer, T_1: 40MVA, 33/220 kV, X= 15%
Transformer, T_2: 30MVA, 11/220 kV, X= 15%



3 For the power system data are given below, obtain the power flow solution using Decoupled load flow method at the end of first iteration. [16M]

Bus code P	Bus code Q	Line impedance in P.u
1	2	0.01+j 0.15
2	3	0.1+j 0.2
3	1	0.15+j 0.35

Bus code	Generation P	Generation Q	Load P	Load Q	$\|V\|$	Reactive power limit Q_{min}	Reactive power limit Q_{max}	Type of bus
1	-	-	-	-	1.04	-	-	Slack bus
2	3	0	-	-	1.02	0	4	P-V bus
3	-	-	2	-	-	-	-	P-Q bus

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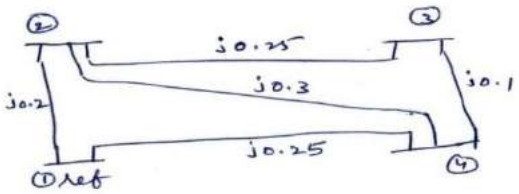
4 Obtain the bus impedance matrix for the power system network shown in below figure by the step by step method. [16M]



5 Two generators are connected in parallel to the LV side of a three phase Δ-Y transformer. Generator1 is rated 60MVA, 11 KV, Generator 2 is rated 30 MVA, 11 kV with same subtransient reactance of 25%. The transformer is rated 90 MVA at 11 Δ / 132Y kV with reactance of 10%. Determine the subtransient current in each generator when a three phase short circuit occurs on the HV side of the transformer. [16M]

6 a) Draw and explain the positive, negative, zero sequence impedance diagrams for different 3-phase transformer winding connections. [8M]

b) What are the different unsymmetrical faults and compare their characteristics. [8M]

7 a) Explain how is the equal area criterion applied when there is a sudden (i) increase in power input and (ii) decrease the power output due to a three phase fault? [8M]

b) A generator rated 75MVA is delivering 0.8 p.u power to a motor through a transmission line of reactance j0.2 p.u. The terminal voltage of the generator is 1.0p.u and that of the motor is also 1.0 p.u. Determine the generator emf behind transient reactance. Also find the maximum power that can be transferred. [8M]

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3. Answer any **THREE** Questions from **Part-B**

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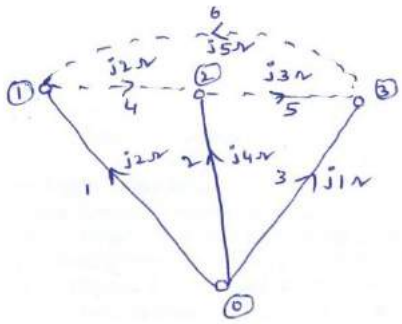
PART –A

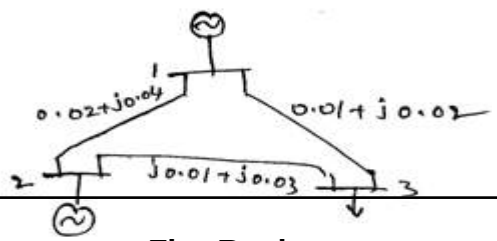
1	a)	What are the merits of per unit quantities in power system?	[4M]
	b)	What is the importance of power flow studies?	[4M]
	c)	Explain the procedure to modify the Z_{Bus} when an element is added to the existing network.	[3M]
	d)	What is meant by fault? How faults are classified.	[4M]
	e)	What are symmetrical components? Why are they used in power system fault calculations?	[4M]
	f)	Discuss the various methods of improving transient stability.	[3M]

PART -B

2	a)	A 50 kW, three phase, Y connected load is fed by a 200 kVA transformer with voltage rating 11 kV/400 V through feeder. The length of the feeder is 0.5 km and the impedance of the feeder is (0.1+j0.2) ohm/km. If the load p.f is 0.8, calculate the p.u impedance of the load and feeder	[6M]
	b)	Obtain Y_{bus} by the singular transformation method for the figure shown below.	[10M]



3		The power system network is as shown below; obtain V_3 using G-S method after first iteration. The impedance values in p.u indicted in the network.	[16M]



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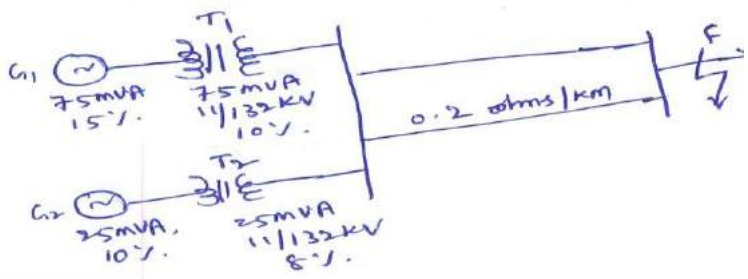
Bus code	$\|V\|$	Generation		Load	
		MW	MVAR	MW	MVAR
1	1.03	-	-	-	-
2	1.0	17		12	8
3	1.0	0	0	50	20

4 Determine the Z_{Bus} for a power system whose element data is given in the following table: [16M]

Element No.	Connected between bus No.	Self reactance (p.u)
1	1-2	0.3
2	1-3	0.4
3	2-3	0.2
4	1-2	0.25

5 A station with two generators feeds through transformers a transmission system operating at 132 kV. The far end of the transmission system consisting of 200 km long double circuit line with 0.2 ohm/km resistance is connected to load from bus B. If a three phase fault occurs at bus B, determine the total fault current and fault current supplied by each generator. [16M]



6 a) What are sequence impedances? Obtain expression for sequence impedances in a balanced static 3- phase circuit. [8M]

b) Derive an expression for the fault current for a double line to ground fault as an unloaded generator and draw its equivalent circuit. [8M]

7 a) What is equal area criterion? Explain how it can be used to study stability. [8M]

b) A two pole, three phase, 20 MVA, 12 kV generator is supplying rated power at 0.85 lagging power factor to an 12 kV bus. Due to a fault the generator output is reduced to 30%. Determine (i) acceleration power and (ii) acceleration at the time of fault. Assume that the KE stored in the moving parts of the generator is 150 MJ. [8M]

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POWER SYSTEM ANALYSIS

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2. Answering the question in **Part-A** is compulsory
3. Answer any **THREE** Questions from **Part-B**

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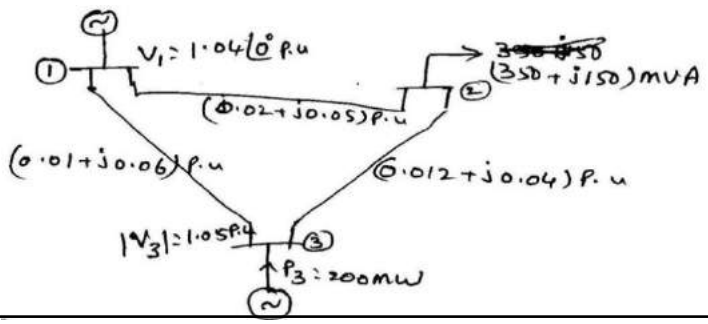
PART –A

1 a) Why do you use a single line diagram for power system representation? [3M]
b) Define the various types of buses of a given power system. [4M]
c) Starting from Z_{bus} for a partial network describe step by step hw you will obtain the Z_{bus} for a modified network when a new line is to be added to a bus in the existing network [4M]
d) What is the need of short circuit studies? [3M]
e) Define the sequence impedances. [4M]
f) State and derive the swing equation. [4M]

PART -B

2 A 300 MVA, 20 kV, three phase generator has a subtransient reactance of 20%. The generator supplies two synchronous motors through a 65 km transmission line having transformers at both ends. In This, first transformer is a three phase, 350 MVA, 20/230 kV, 10% reactance and second one is made of three single phase transformers of rating 100 MVA, 127/13.2 KV, 10% reactance. Synchronous motors ratings are 200 MVA and 100 MVA and both operating at 13.2 kV with 20% subtransient reactance. Series reactance of transmission line is 0.5 ohm/ Km. Draw the reactance diagram with all the reactance's marked in p.u. [16M]

3 Single line diagram of a simple power system with generators at buses 1 and 3 shown in below figure. The necessary data are given in the figure. Line impedances are marked in p.u. on a 100MVA base. Determine the following using Fast decoupled load flow method at the end of first iteration. [16M]
i)Voltage at buses 2 and 3, and ii) Slack bus power



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4 Determine the Z_{Bus} for a power system whose element data is given in the following table [16M]

Element No.	Connected between bus No.	Self reactance (p.u)
1	1-2	0.25
2	1-3	0.15
3	2-3	0.4

5 A 33 kV line has an impedance of (4+ j16) ohm, is connected to a generating station bus bar through a 6 MVA step up transformer which has a reactance of 6%. The station has two generators rated 10 MVA with 10% reactance and 5 MVA with 5% reactance. Calculate the fault current and short circuit MVA when a three phase fault occurs at the HV terminal of the transformer and at the end of the line. [16M]

6 a) Explain the sequence networks for a synchronous generator. [8M]
b) Derive an expression for the fault current for a double line fault as an unloaded generator and draw its equivalent circuit. [8M]

7 a) Define synchronous power coefficient? Explain its significance. [8M]
b) Draw a diagram to illustrate the application of equal area criterion to study transient stability when there is a sudden increase in the input of generator. [8M]

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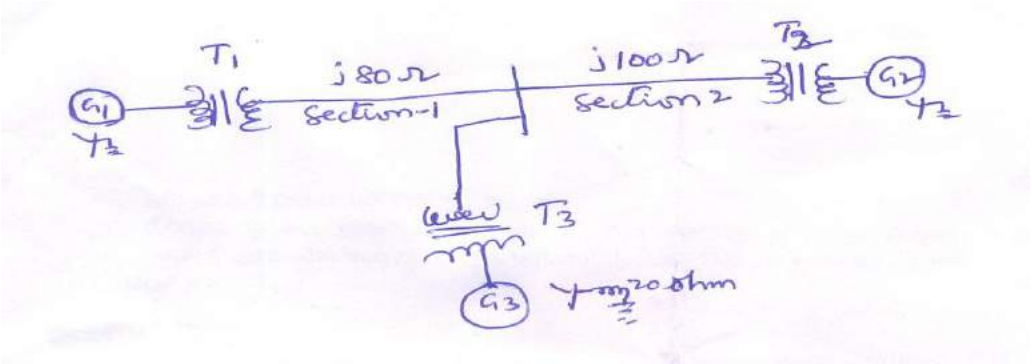
PART –A

1 a) Define the Tree of a given graph and mention its properties. [3M]
b) Contrast between decoupled and fast decoupled load flow methods. [4M]
c) List the merits of Z_{bus} building algorithm. [3M]
d) How will you determine the synchronous, transient ad sub transient reactance's from the oscillations of the short circuit current. [4M]
e) Derive an expression for power in a 3-phase circuit interms of symmetrical components. [4M]
f) How stability studies are classified. What are they? [4M]

PART -B

2 The single line diagram of an unloaded power system is show in below figure. The ratings of the generators and transformers as follows: [16M]
G1 = 20 MVA,13.8 kV, X"=20%
G2 = 30 MVA,18 kV, X"=20%
G3 = 30 MVA,20 kV, X"=20%
T1 = 25 MVA,220/13.8 kV, X=10%
T2 = 3 single phase units each rated at 10 MVA,127/18 kV, X=10%
T3 = 35 MVA,220/22 kV, X=10%
Draw the reactance diagram using the base of 50MVA and 13.8 kV on the generator G1.



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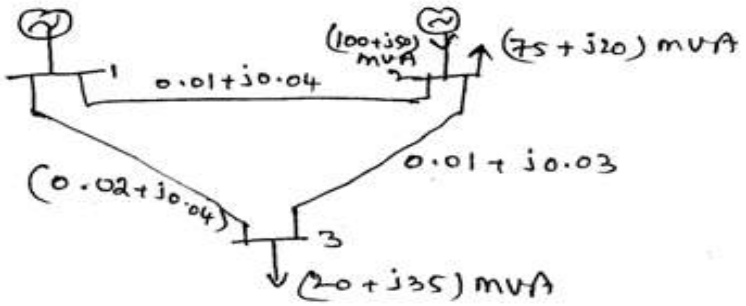
3 The power system network shown in below network, bus 1 is connected as a slack bus of voltage 1.0 $\angle 0^0$ p.u . The line impedances are indicated in the network on 100 MVA base and neglect the line shunt admittance [16M]

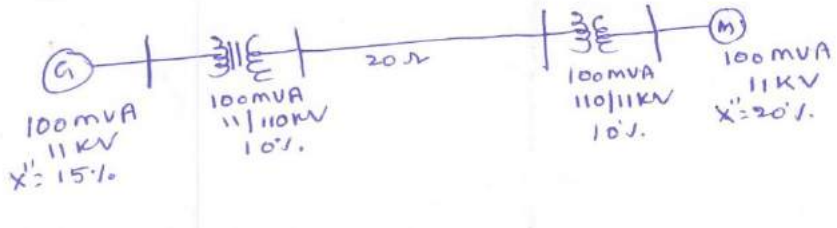


By using N-R method at the end of first iteration, determine the voltage magnitude and phase angle at buses 2 and 3.

4 Build the Z_{Bus} for a power system whose element data is given in the following table: [16M]

Element No.	Connected between bus No.	Self reactance (p.u)
1	1-2	0.3
2	1-3	0.4
3	2-3	0.2
4	1-3	0.1

5 Consider the power system shown in below figure. [16M]



The synchronous generator is operating at its rated MVA at 0.95 lagging p.f and at rated voltage. A 3-phse short circuit occurs at bus A, calculate the p.u value of (i) subtransient fault current, (ii) subtransient generator and motor currents. Neglect pre fault current. Also compute (iii) subtransient generator and motor currents including the effect of pre fault currents.

6 a) What are symmetrical components? Explain. [8M]
b) Derive an expression for the fault current for a single line to ground fault as an unloaded generator and draw its equivalent circuit. [8M]

7 a) Draw and explain power angle curve of a synchronous machine. [8M]
b) Describe how equal are criterion can be used for calculating the critical clearing angle. [8M]

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