Code No: R1932022 **R19** **SET - 1**

III B. Tech II Semester Regular Examinations, June-2022

POWER SYSTEM ANALYSIS

(Electrical and Electronics Engineering)

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions **ONE** Question from **Each unit**

All Questions Carry Equal Marks

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UNIT-I

1. a) Develop the relation between bus admittance matrix, bus incidence matrix and primitive admittance matrix. [8M]

   b) For the transmission system with the following line specifications, compute the bus admittance matrix: [7M]

Bus code	Line Impedance (p.u)	Half Line charging admittance (p.u)
1-2	0.08+ j 0.32	j 0.04
1-3	0.04+ j 0.16	j 0.03
2-3	0.02+ j 0.08	j 0.01

(OR)

2. Three phase generators G_1 and G_2 supply motor loads M_1, M_2 and M_3, as shown in Fig.1. Transformers T_1 and T_2 are rated at 100 MVA and 33/10 kV, each has a reactance of 0.08 p.u. Assume 100 MVA and 33 kV are used as base values, obtain all the reactance's as per unit values and draw p.u reactance diagram. [15M]

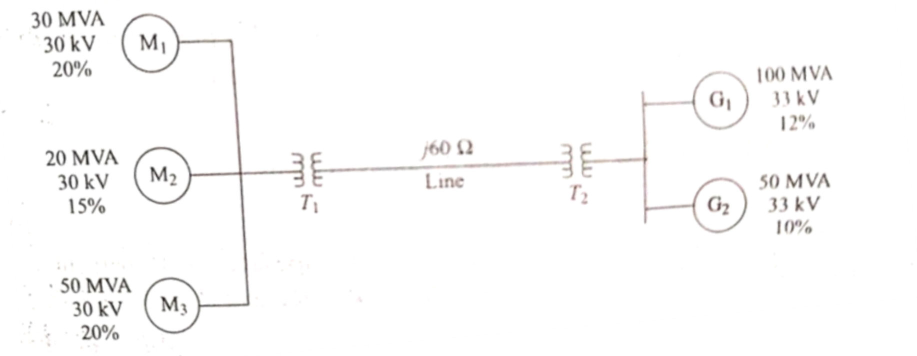

Fig.1

UNIT-II

3. a) Explain the necessity of power flow studies. [6M]

   b) Write an algorithm for computational procedure for load flow solution using Gauss-Seidal method when the system contains all types of buses. [9M]

|''|'|'|''||''||||

(OR)

4. a) Explain the polar coordinates method of Newton–Raphson load flow solution. [8M]

   b) Compare the Newton–Raphson method, decoupled method and fast decoupled method. [7M]

UNIT-III

5. Form the bus impedance matrix for the network shown, in Fig.2, using building algorithm. [15M]

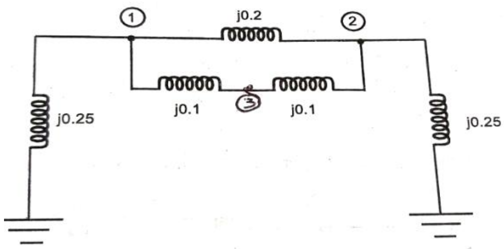

Fig.2

(OR)

6. a) What do you understand by short circuit MVA? Explain. [5M]

   b) A power plant has three generating units each rated at 7500 kVA with 15 % reactance. The plant is protected by a tie line system. With reactance's rated at 7500 MVA and 6 %, determine the fault kVA when a short circuit occurs on one of the sections of bus bars. If the reactors were not present what would be the fault kVA? [10M]

UNIT-IV

7. a) What are symmetrical components? Explain. [8M]

   b) A positive, negative and zero sequence components of line currents are $20\angle 10^0$ A, $6\angle 60^0$ A and $3\angle 30^0$ A respectively. Determine the three line currents, assume (i) phase sequence abc and (ii) phase sequence acb. [7M]

(OR)

8. a) Draw the sequence network connection for a double line to ground fault at any point in a power system and from that obtain an expression for the fault current. [8M]

   b) A three phase, 6.9 kVA, 10 MVA alternator has X" = X_2 = 15 % and X_0 = 5%. The neutral is grounded through a reactor of 0.381 Ohms. Find the sub transient current in the faulted phase, when a single line to ground fault takes place. [7M]

|''|'||'||''||||

UNIT-V

9. a) Derive swing equation for a single machine connected to infinite bus system. State the assumptions if any and state the usefulness of this equation. [8M]

b) Two synchronous machines of equal rating have internal voltages of (1.1 + j0.5) and (0.8 –j 0.4) p.u, respectively. The machines are connected by a line of 50 km length having only reactance and the second machine receives power of 0.9 p.u. Determine the reactance of the line per km length. Assume that there is no internal reactance for simplification. [7M]

(OR)

10. a) Describe the recent methods to improve the transient stability. [7M]

b) A generator is supplying 0.8 p.u power to infinite bus system through a reactive transmission network. The maximum power which can be delivered is 2 p.u. A three phase fault occurs on the system and hence the maximum power which can be delivered by the generator, reduces to 0.5 p.u. In the post fault condition, the maximum power which the generator can deliver is 1.5 p.u. Compute critical clearing angle by applying equal area criterion. [8M]

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Code No: R1932022 **R19** **SET - 2**

III B. Tech II Semester Regular Examinations, June-2022

POWER SYSTEM ANALYSIS

(Electrical and Electronics Engineering)

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions **ONE** Question from **Each unit**

All Questions Carry Equal Marks

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UNIT-I

1. a) What is meant by a primitive network? Give the representation of a network component in admittance form. [7M]

   b) For the transmission system with the following line specifications, form the bus admittance matrix by direct inspection method. [8M]

Bus code p-q	Impedance, p.u ($Z_{p\text{-}q}$)	Half Line charging admittance, p.u $\left(\frac{Y'_{PQ}}{2}\right)$
1-2	0.02+ j 0.04	j 0.02
2-3	0.04+ j 0.2	j 0.02
3-5	0.15+ j 0.4	j 0.025
3-4	0.02+ j 0.06	j 0.01
4-5	0.02+ j 0.04	j 0.01
1-5	0.08+ j 0.2	j 0.02

(OR)

2. Draw a per unit reactance diagram for the system shown in Fig.1. [15M]

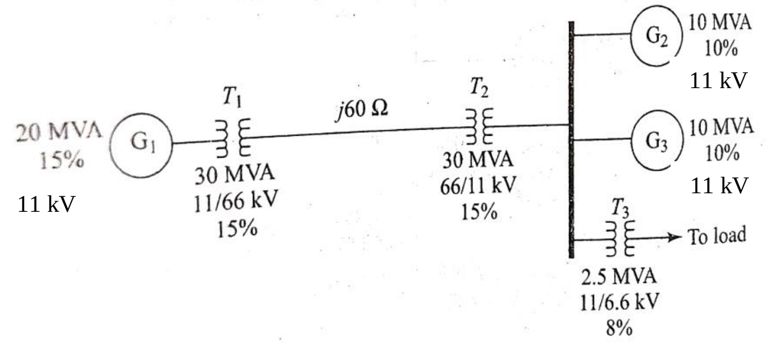

Fig.1

UNIT-II

3. a) Derive the static load flow equations of a power system. [6M]

   b) Discuss the various types of buses and their significance in details. [9M]

|'''|'|'|''||'''||||

(OR)

4. The following data are given for a three bus power system: [15M]

Bus 1 slack bus V specified = $1.05\angle 0^0$

Bus 2 PV bus $|V|$ specified = 1.02 p.u, P_G = 3 p.u

Bus 3 PQ bus P_L = 4 p.u, Q_L = 2 p.u

Line reactance in p.u are given below:

Bus code	Impedance
1-2	j 0.5
2-3	j 0.5
3-1	j 0.5

Carry out one iteration of load flow solution using Gauss-Seidal method. Take Q limits of generator 2 as $0 \leq Q \leq 4$.

UNIT-III

5. For the system shown in Fig.2, form the bus impedance matrix using building algorithm. [15M]

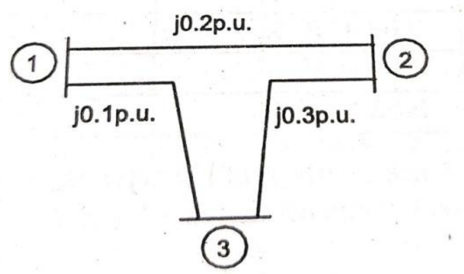

Fig.2

(OR)

6. a) Explain the three phase short circuit currents on unloaded synchronous generator with neat diagrams. [8M]

b) A three phase, 25 MVA, 11 kV alternator has internal reactance of 6 %. Find the external reactance per phase to be connected in series with the alternator so that steady state short circuit current does not exceed six times the full load current. [7M]

UNIT-IV

7. a) Derive an expression for power in a 3-phase circuit in terms of symmetrical components. [8M]

b) Obtain the expression for fault current of LLL fault occur at terminals of unloaded alternator and draw its equivalent circuit. [7M]

(OR)

8. a) Derive an expression for the fault current for a double line fault as an unloaded generator and draw its equivalent diagram. [7M]

b) A generator of negligible resistance having 1.0 p.u voltage behind transient reactance is subjected to different types of faults. The p.u values of the magnitudes of the fault currents are 3 phase fault-3.33 p.u., line to line fault-2.23 p.u and line to ground fault-3.01 p.u. Find the percentage values of sequence reactance's. [8M]

UNIT-V

9. a) State the bad effects of instability. Distinguish between steady state and transient stabilities. [8M]

b) A 50 Hz, 4 pole turbo alternator rated 100 MVA, 11 kV has an inertia constant of 8 MJ/MVA. Find (i) the energy stored in the rotor at synchronous speed and (ii) the rotor acceleration, if the mechanical input is suddenly raised to 80 MW for an electric load of 50 MW. (Neglect mechanical and electrical losses). [7M]

(OR)

10. a) State and explain equal area criterion. [8M]

b) Discuss the methods by which the transient stability can be improved. [7M]

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III B. Tech II Semester Regular Examinations, June-2022

POWER SYSTEM ANALYSIS

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UNIT-I

1. a) Using the graph theory concepts, explain the following matrices: (i) Element node incidence matrix and (ii) bus incidence matrix. [7M]

   b) Form the Y_{bus} by inspection for a 4 bus system, if the line series impedances are as given below: [8M]

Line (bus to bus)	Impedance (p.u)
1-2	0.15+ j 0.6
1-3	0.1+ j 0.4
1-4	0.15+ j 0.6
2-3	0.05+ j 0.2
3-4	0.05+ j 0.2

(OR)

2. Draw an impedance diagram for the system shown in Fig.1, expressing all values as per unit values. [15M]

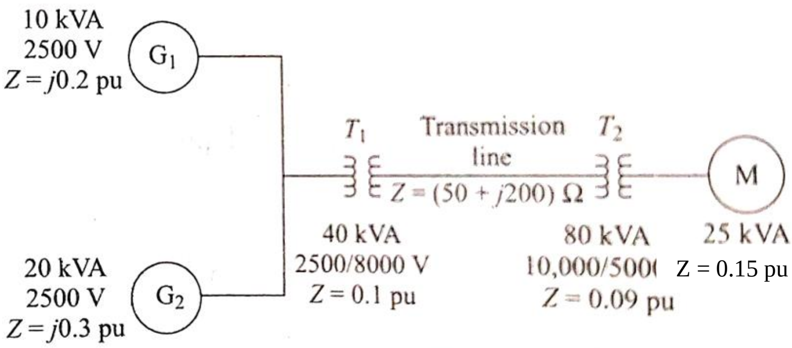

Fig.1

UNIT-II

3. a) Compare Gauss-Seidal method and Newton-Raphson method in detail. [8M]

   b) Derive the basic equations for load flow study using Gauss-Seidal method. [7M]

(OR)

4. The following data, given in Fig.2, pertains to a simple three bus power system. Compute the three bus voltages at the end of first iteration using fast decoupled method. The line impedances shown are in p.u. The bus data is as follows (all data in p.u): [15M]

Bus	P_G	Q_G	P_L	Q_L	$\lvert V_{SP} \rvert$
1 (Slack)	-	-	-	-	1.0
2 (PV)	5.3217	-	-	-	1.1
3 (PQ)	-	-	3.6392	0.5339	-

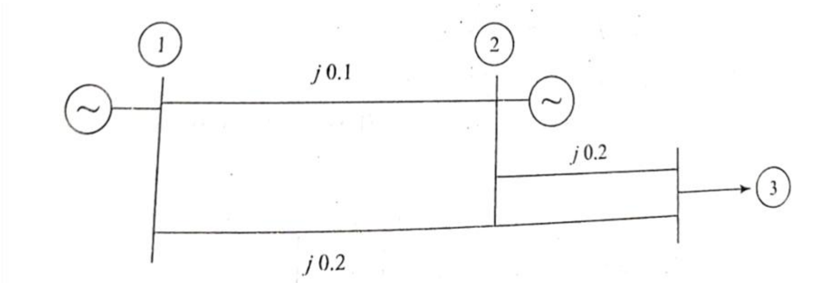

Fig.2

UNIT-III

5. Determine Z_{bus} for the networks shown, in Fig.3, using building algorithm. [15M]

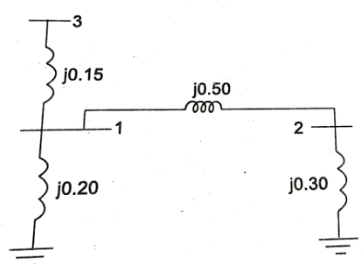

Fig.3

(OR)

6. a) Explain the reactance's of synchronous machine under three phase short circuit occurs at its terminals. [6M]

b) There are two generators at bus bar A each rated at 12000 kVA, 12 % reactance or another bus B, two more generators rated at 10000 kVA with 10 % reactance are connected. The two bus bars are connected through a reactor rated at 5000 kVA with 10% reactance. If the dead short circuit occurs between all the phases on bus bar B, what is the short circuit MVA fed into the fault? [9M]

UNIT-IV

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

   b) Determine the symmetrical components for the three phase currents. [7M]

$I_R = 15\angle 0^0$ A, $I_Y = 15\angle 230^0$ A and $I_B = 15\angle 130^0$ A

(OR)

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

   b) A 20 MVA, 6.6 kV star connected generator has positive, negative and zero sequence reactance's of 30%, 25% and 7% respectively. A reactor with 5% reactance based on the rating of the generator is placed in the neutral to ground connection. A line to ground fault occurs at the terminals of the generator when it is operating at rated voltage. Find the initial symmetrical line to ground rms fault current. Also find the line to line voltages. [7M]

UNIT-V

9. a) Explain the steady-state stability with necessary expressions. [8M]

   b) Describe the methods to improve steady-state stability. [7M]

(OR)

10. a) Derive an expression for the critical clearing angle for a power system consisting of a single machine supplying to an infinite bus, for a sudden load increment. [8M]

    b) Find the steady state power limit of a system consisting of a generator with a synchronous reactance of 0.4 p.u connected to an infinite bus through a series reactance of 1.0 p.u. The terminal voltage is held at 1.0 p.u and the infinite bus voltage is 1.0 p.u. [7M]

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Code No: R1932022 **R19** **SET - 4**

III B. Tech II Semester Regular Examinations, June-2022

POWER SYSTEM ANALYSIS

(Electrical and Electronics Engineering)

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions **ONE** Question from **Each unit**

All Questions Carry Equal Marks

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UNIT-I

1. a) By using transformation of primitive admittance matrix y, prove that bus admittance matrix, $Y_{BUS} = A^T[y]A$. [7M]

b) For the transmission system with the following line specifications, determine the bus admittance matrix. [8M]

Bus code p-q	Impedance Z_{p-q}, p.u	Bus code	Half Line charging admittance, $(\frac{Y'_{PQ}}{2})$ p.u
1-2	0.06+ j 0.18	1	j 0.05
1-3	0.02+ j 0.06	2	j 0.06
2-3	0.04+ j 0.12	3	j 0.05

(OR)

2. Draw an impedance diagram for the system, shown in Fig.1, expressing all values as per unit values. [15M]

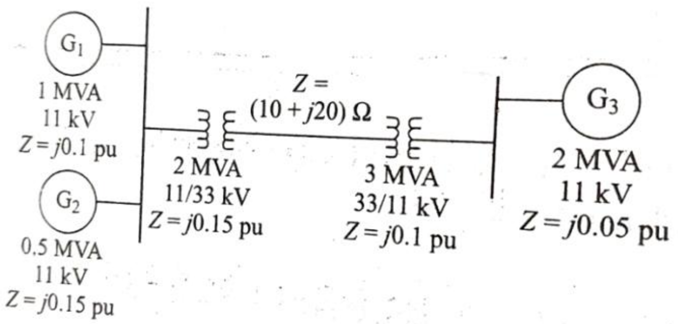

Fig.1

UNIT-II

3. Carry out one iteration of load flow analysis of the system given below by Gauss-Seidal method. [15M]

Bus No.	Bus Type	$\|V\|$ p.u	p.u. generation		p.u load	
			P	Q	P	Q
1	Slack	1.02	-	-	-	-
2	P-V	1.0	0.8	-	-	-
3	P-Q	--	-	-	1.0	0.4

Line reactance's in p.u are given below:

Bus code	Reactance
1-2	j 0.5
2-3	j 0.5
3-1	j 0.5

(OR)

4. a) Derive the basic equations for load flow study using decoupled method. [7M]

   b) Write an algorithm for computational procedure for load flow solution using Newton-Raphson polar coordinates form method when the system contains all types of buses. [8M]

UNIT-III

5. Using the method of building algorithm find the bus impedance matrix for the network shown in Fig.2. [15M]

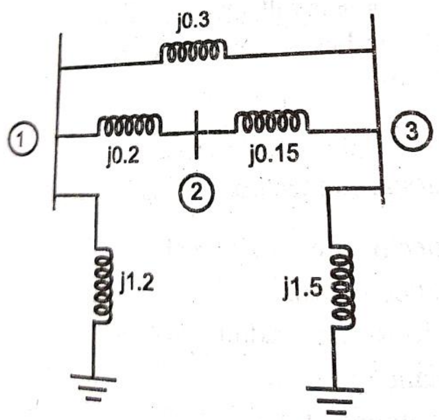

Fig.2

(OR)

6. a) Draw the oscillogram of short circuit current, when an unloaded generator is subjected to symmetrical fault, clearly marking sub-transient, transient and steady state regions. Discuss them. [8M]

   b) A synchronous generator rated at 500 kVA, 440 V, 0.1 p.u sub transient reactance is supplying a passive load of 400 kW at 0.8 p.f lagging. Calculate the initial symmetrical RMS current for a 3-phase fault at the generator terminals. [7M]

UNIT-IV

7. a) Explain the sequence networks for an synchronous generator. [5M]

   b) The line voltages across a three phase, wye-connected load, consisting of a 10 ohm resistance in each phase are unbalanced such that $V_{ab} = 1\angle 132^0$ V, $V_{bc} = 252\angle 0^0$ V and $V_{ca} = 195\angle 122^0$ V. Determine the sequence phase voltages. Then find the voltages across the 10 Ohm resistances and calculate line currents. [10M]

(OR)

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

   b) A 125 MVA, 22 kV turbo generator having $X_d'' = X_1 = X_2 = 22$ % and $X_0 = 6\%$ has a current limiting reactor of 0.16 Ohm in the neutral, while it is operating on no-load at rated voltage a double line to ground fault occurs on two phases. Find the initial symmetrical rms fault current to the ground. [7M]

UNIT-V

9. a) Discuss the various methods of improving steady state stability [8M]

   b) Generator rated 75 MVA 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 1.0 p.u and that of the motor is also 1.0 p.u. Determine the generated e.m.f. behind transient reactance. Fins also the maximum power that can be transferred. [7M]

(OR)

10. a) A double circuit line feeds an infinite bus from a power station. If a fault occurs on one of the lines and the line is switched off, derive an expression for the critical clearing angle. [8M]

    b) Describe the methods of improving the transient stability limit of a power system. [7M]

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