Reg. No. : | | | | | | | | | | | | |

Question Paper Code : X 20489

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2020
Fifth Semester
Electrical and Electronics Engineering
EE 6501 – POWER SYSTEM ANALYSIS
(Regulations 2013)
(Common to PTEE 6501 – Power System Analysis for B.E. Part-Time Fifth Semester-Electrical and Electronics Engineering – Regulations 2014)

Time : Three Hours Maximum : 100 Marks

Answer ALL questions

PART – A **(10×2=20 Marks)**

1. State the advantage of per unit analysis.

2. How are the loads represented in the reactance and impedance diagram ?

3. What is the need for load flow study ?

4. When does generator bus treated as load bus ?

5. What is the significance of subtransient reactance and transient reactance in short circuit studies ?

6. For a fault at a given location, rank the various faults in the order of severity.

7. What are the advantages of symmetrical components ?

8. What is a solid fault or bolted fault ?

9. What are coherent machines ?

10. How to improve the transient stability limit of the power system ?

PART – B **(5×13=65 Marks)**

11. a) Draw the reactance diagram for the power system shown in Fig. 1. Neglect resistance and use a base of 50 MVA and 13.8 KV on generator G_1

G_1 : 20 MVA, 13.8 KV, X″ = 20%

G_2 : 30 MVA, 18.0 KV, X″ = 20%

G_3 : 30 MVA, 20.0 KV, X″ = 20%

T_1 : 25 MVA, 220/13.8 KV, X = 10%

T_2 : 3 Single phase unit each rated 10 MVA, 127/18 KV, X = 10%

T_3 : 35 MVA, 220/22 KV, X = 10%

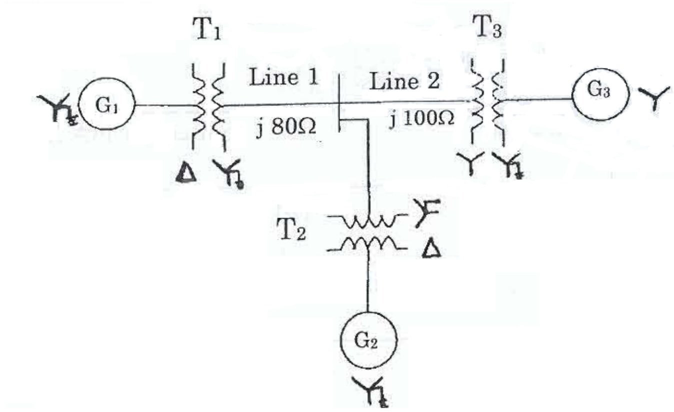


Fig. 1

Determine the new values of per unit reactance of G_1, T_1, Transmission line 1, Transmission line 2, G_2, T_2, G_3 and T_3.

(OR)

b) Form Y_{bus} of the test system shown in Fig. 2 using singular transformation method. The impedance data is given in Table 1. Assume node 1 as reference node.

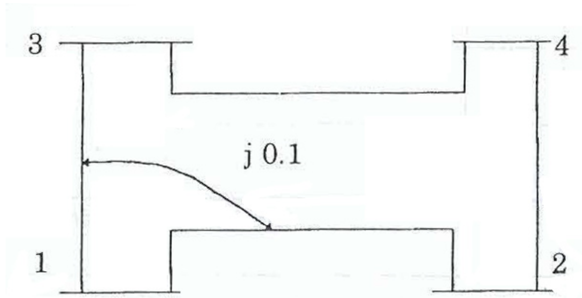


Fig. 2

Table 1

Element No.	Self		Mutual	
	Bus code	**Impedance**	**Bus code**	**Impedance**
1	1 – 2	0.5	1 – 2	0.1
2	1 – 3	0.6		
3	3 – 4	0.4		
4	2 – 4	0.3		

12. a) With a neat flow chart, explain the computational procedure for load flow solution using Newton Raphson iterative method when the system contains all types of buses.

(OR)

b) Single line diagram of a simple power system, with generators at busses 1 and 3 is shown in Fig. 12. b) The magnitude of voltage at bus 1 is 1.05 p.u. Voltage magnitude at bus 3 is fixed at 1.04 p.u. with active power generation of 200 MW. A load consisting of 400 MW and 250 MVAR is taken from bus 2. Line impedances are marked in p.u. on a 100 MVA base and the line charging susceptances are neglected.

Determine the voltage at buses 2 and 3 using Gauss-Seidal method at the end of first iteration. Also calculate Slack bus power.

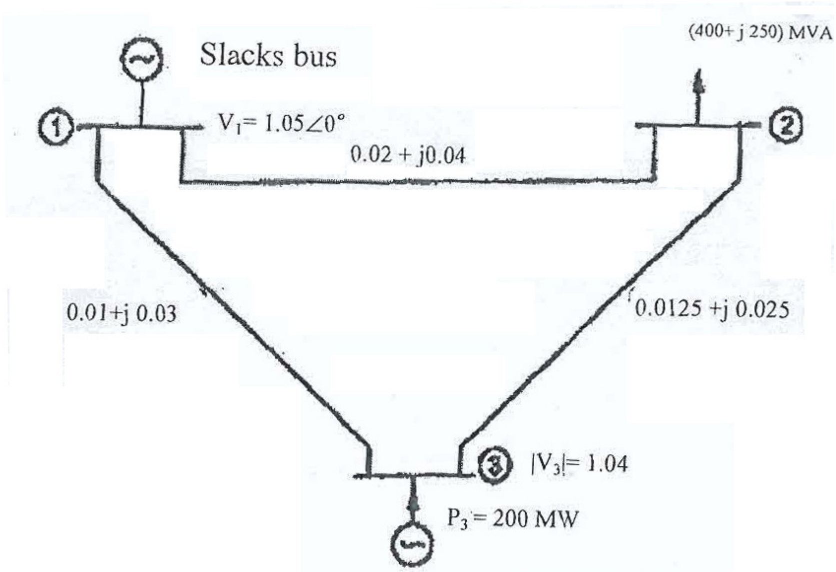
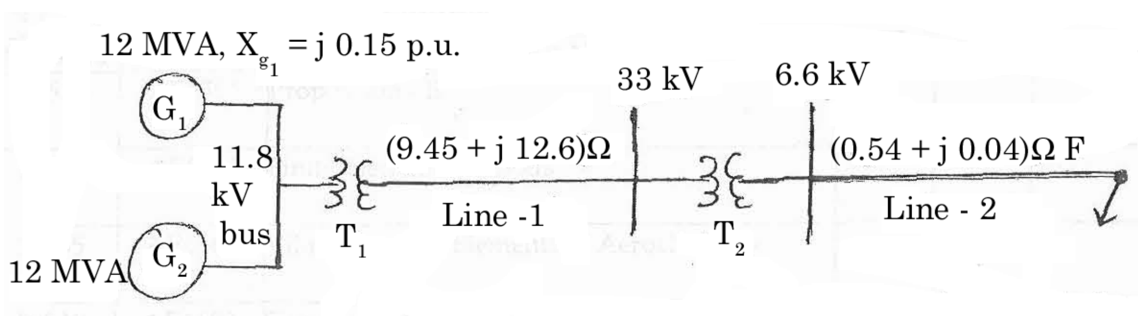


Fig. 12. b)

13. a) For the radial network shown in Fig. 13. a) 3Φ fault occurs at point F. Determine the fault current and the line voltage at 11.8 kV bus under fault condition.



X_{g_2} = j 0.12 p.u.

T_1 : 12 MVA, XT_1 = j 0.12 p.u.

T_2 : 3 MVA, XT_2 = j 0.08 p.u.

Fig. 13. a)

(OR)

b) A 3 phase, 5 MVA, 6.6 kV alternator with a reactance of 8% is connected to a feeder series impedance (0.12 + j0.48) ohm/phase/km through a step up transformer. The transformer is rated at 3 MVA, 6.6 kV/33 kV 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 phase symmetrical fault occurs at a point 15 km along the feeder. **(13)**

14. a) i) Derive the relationship for fault currents in terms of symmetrical components when there is a line-to-ground (L-G) fault on phase a. Also draw a diagram showing interconnection of sequence networks for L-G fault. **(6)**

ii) Show that positive and negative sequence currents are equal in magnitude but out of phase by 180 deg. in a line-to-line fault. **(7)**

(OR)

b) Two 11 kV, 20 MVA, three phase, star connected generators operate in parallel as shown in Fig. 14. b) the positive, negative and zero sequence reactances of each being, respectively, j0.18, j0.15, j0.10 p.u. The star point of one of the generators is isolated and that of the other is earthed through a 2.0 ohm resistor. A single line-to-ground fault occurs at the terminals of one of the generators.

Estimate :

i) the fault current **(4)**

ii) current in grounding resistor and **(4)**

iii) the voltage across grounding resistor. **(5)**

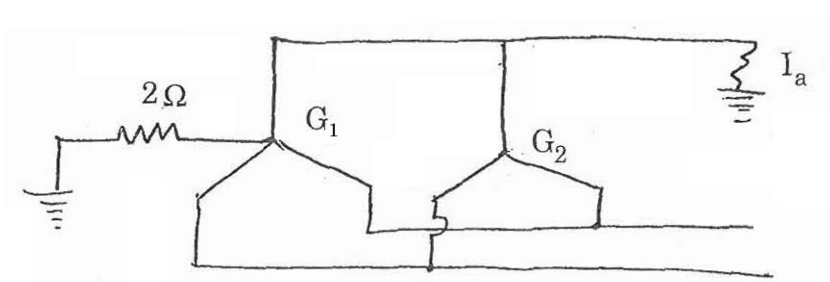


Fig. 14. b)

15. a) Write the swing equation describing the rotor dynamics of a synchronous machine connected to infinite bus through a double circuit transmission line. **(13)**

(OR)

b) The per unit system reactances that are converted in a common base, are shown in this Figure. 6. Let us assume that the infinite bus voltage is $1\angle 0°$. The generator is delivering 1.0 per unit real power at a lagging power factor of 0.9839 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, find the critical clearing time for various values of H. **(13)**

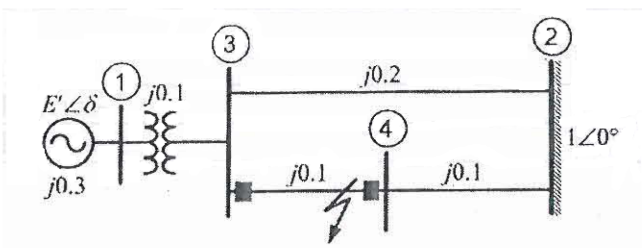


Figure. 6

PART – C **(1×15=15 Marks)**

16. a) Derive the expression for fault current in line-to-line fault on unloaded generator. Draw its equivalent network showing the interconnection of networks to simulate line-to-line fault. **(15)**

(OR)

b) A synchronous motor is receiving 40% of the power that it is capable of receiving from an infinite bus. If the load on the motor is doubled, calculate the maximum value of 'δ' during the swinging of the motor around its new equilibrium position. **(15)**
