Reg. No. ____________

Question Paper Code : 27218

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2015.

Fifth Semester

Electrical and Electronics Engineering

EE 6501 – POWER SYSTEM ANALYSIS

(Regulations 2013)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. What is single line diagram?

2. Define per unit value.

3. What is the need for load flow study?

4. When is generator bus treated as load bus?

5. Why do faults occur in a power system?

6. What is direct axis reactance?

7. What are the symmetrical components of a three phase system?

8. What is the sequence operator?

9. How is the power system stability classified?

10. Write the power angle equation?

PART B — (5 × 16 = 80 marks)

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

G_1 : 20MVA, 13.8KV, X" = 20%

G_2 : 30MVA, 18.0KV, X" = 20%

G_3 : 30MVA, 20.0KV, X" = 20%

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

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

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

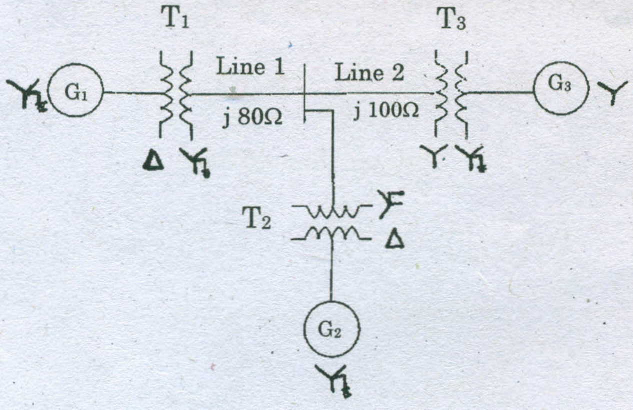

Fig. 1

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. Take (1) as reference node.

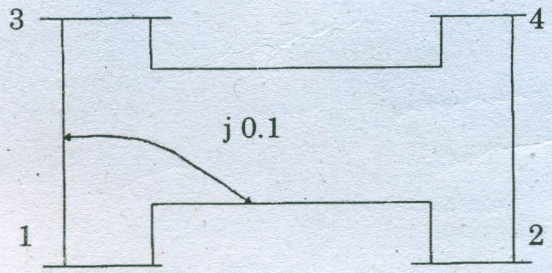

Fig. 2

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) The system data for a load flow solution are given in Tables 2 and 3. Determine the voltages at the end of the first iteration using the Gauss-Seidel method. Take $\alpha = 1.6$.

Table 2 : Line admittances

Bus code	Admittance
1-2	2–j8.0
1-3	1–j4.0
2-3	0.666–j2.664
2-4	1–j4.0
3-4	2–j8.0

Table 3: Schedule of active and reactive powers

Bus Code	P in p.u	Q in p.u	V in p.u	Remarks
1	–	–	1.06	Slack
2	0.5	0.2	1+j0.0	PQ
3	0.4	0.3	1+j0.0	PQ
4	0.3	0.1	1+j0.0	PQ

Or

(b) Draw and explain the step by step procedure of load flow solution for the Gauss seidel method when PV buses are present.

13. (a) Generator G1 and G2 are identical and rated 11KV, 20MVA and have a transient reactance of 0.25 p.u at own MVA base. The transformers T1 and T2 are also identical and are rated 11/66KV, 5MVA and have a reactance of 0.06 p.u to their own MVA base. A 50km long transmission line is connected between the two generators. Calculate three phase fault current, when fault occurs at middle of the line as shown in fig. 3.

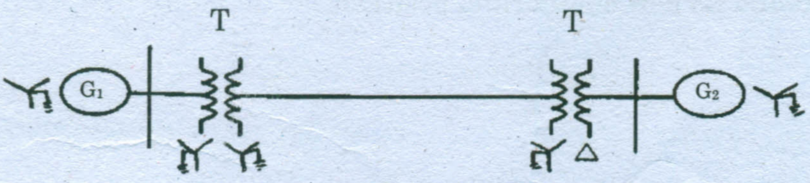

Fig. 3

Or

(b) A synchronous generator and synchronous motor each rated 30 MVA, 13.2 KV and both have subtransient reactance of 20% and the line reactance of 12% on a base of machine ratings. The motor is drawing 25 MW at 0.85 p.f leading. The terminal voltage is 12KV when a three phase short circuit fault occurs at motor terminals. Find the subtransient current in generator, motor and at the fault point.

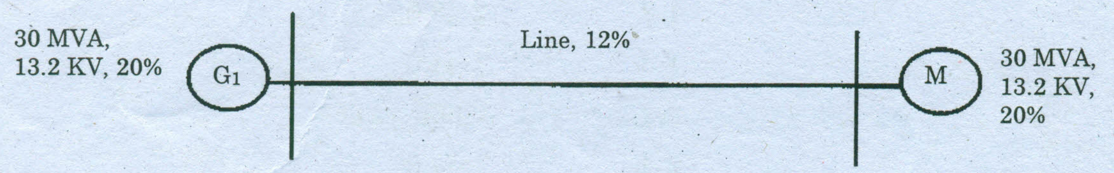

Fig.4

14. (a) Derive the expression for the three phase power in terms of symmetrical components.

Or

(b) A 30 MVA, 11 KV, 3ϕ synchronous generator has a direct subtransient reactance of 0.25 p.u. The negative and zero sequence reactance are 0.35 and 0.1 p.u respectively. The neutral of the generator is solidly grounded. Determine the subtransient current in the generator and the line to line voltages for subtransient conditions when a single line to ground fault occurs at the generator terminals with the generator operating unloaded at rated voltage.

15. (a) (i) Derive the expression for swing equation. (10)

(ii) The moment of inertia of a 4 pole, 100 MVA, 11 kV, $3-\phi$, 0.8 power factor, 50 HZ turbo alternator is 10000 kg-m^2. Calculate H and M. (6)

Or

(b) A synchronous motor is receiving 30% 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.
