Paper Code: EE-601 **Roll No.** | | | | | | | | | | |

B.Tech.
(SEM VI) EVEN SEMESTER EXAMINATION 2015-16
POWER SYSTEM ANALYSIS

[Time: 3 hrs.] **[Max. Marks: 100]**

Note- Attempt All Questions. All carry equal marks

Q 1. Attempt any two parts of the following:- [10x2=20]

a) The single line diagram of a three phase power system I shown in figure 1 below. Select a common base of 100 MVA and 13.8 kV on the generator side. Draw the per unit impedance diagram with new values p.u. reactance.
G: 90 MVA, 13.8 kV, X=18%, line 1: j50 Ω, line 2: j70 Ω
T1: 50 MVA, 13.8/220 kV, X= 10%, T3: 50 MVA, 13.8/132 kV, X= 10%
T2: 50 MVA, 220/11 kV, X= 10%, T4: 50 MVA, 132/11 kV, X= 10%
M: 80 MVA, 10.45 kV, X= 20%, Load: 57 MVA, 0.8 pf lag at 10.45 kV

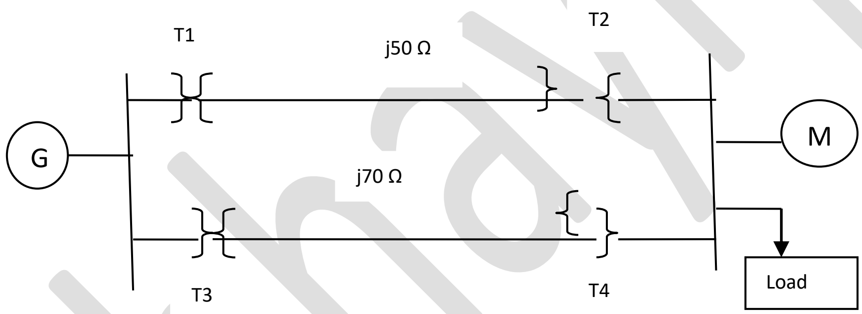

Fig.1

b) Define doubling effect and explain transients on a synchronous machine, when a three phase short circuit fault occurs.

c) A synchronous generator and motor each rated 30 MVA, 13.2 kV and both have sub-transient 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. lead. The terminal voltage is 12 kV when a three phase short circuit fault occurs at motor terminals. Determine the sub-transient current in generator, motor and at the fault point.

Q 2. Attempt any two parts of the following: - [10x2=20]

a) Prove that three phase power remains invariant even when calculated from symmetrical component technique. Also carry out analysis of line to line fault using symmetrical components.

b) An alternator of negligible resistance with solidly grounded neutral having rated voltage at no load condition is subjected to different types of fault at its terminal. The p.u values of the magnitude of the fault currents are (i) 3-Ø fault = 4.0 pu (ii) L-G fault = 4.2875 pu (iii) L-L fault = 2.8868 pu. Determine the p.u values of the sequence reactances of the machine.

c) Draw the zero sequence network of the power system as shown in the figure 2 below. Data are give as follows

G: X_{g0} = 0.05 pu　　　　M: X_{m0} = 0.03 pu

T1: X_{t1} = 0.12 pu　　　　T2: X_{t2} = 0.10 pu

line 1, line 2: X_{l0} = 0.70 pu

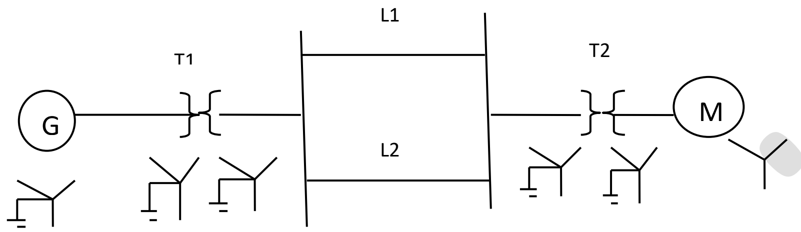

Fig. 2

Q. 3 Attempt any two parts of the following:- [10x2=20]

a) Describe and classify Transient stability in power systems. How the stability can be analyzed using swing curve?

b) A power station with 4 generators each 80 MVA, 8 MJ/MVA is in proximity with another power station having 3 generators each 200 MVA, 3.5 MJ/MVA. Determine the inertia constant of a single equivalent machine for use in stability studies. Assume a base value of 100 MVA.

c) Given the circuit as shown in the figure 3 below where a three phase fault is applied on one end of a line near CB_4. Find the critical fault clearing angle for clearing the fault with simultaneous opening of breakers CB2 and CB4. The generator is delivering 1.0 pu MW at the instant preceding the fault. All the pu quantities are on common MVA.

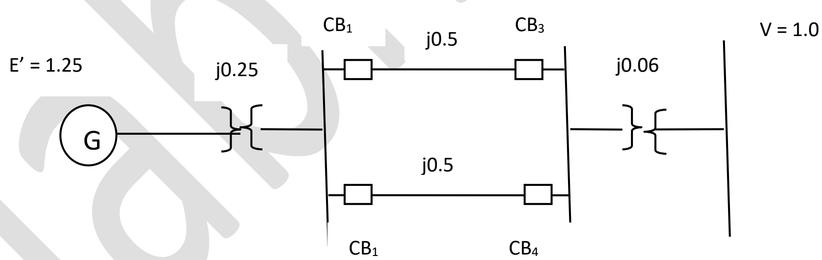

Fig. 3

Q. 4 Attempt any two parts of the following:- [10x2=20]

a) State the importance of admittance matrix in Load flow analysis. Also draw the flow chart of Gauss Seidel Method when PV bus is present.

b) The system data for a load flow solution are given in Tables 1 and 2. Determine the voltages at the end of the first iteration using G-S method. Take convergence factor α = 1.6.

Table 1: line admittances

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

Table 2: Schedule of active and reactive powers

Bus code	P (pu)	Q (pu)	V (pu)	Remarks
1	-	-	1.06	Slack
2	0.5	0.2	1+j0	PQ
3	0.4	0.3	1+j0	PQ
4	0.3	0.1	1+j0	PQ

c) What is the significance of Jacobian matrix in N-R method? How this matrix is modified in Fast Decoupled method citing valid reasons? Further compare G-S, N-R, FDLF methods used for Load Flow Analysis.

Q. 5 Attempt any two parts of the following:- [10x2=20]

a) Describe how the equipments connected at the receiving end are subjected to low voltage when a travelling wave (TW) of high magnitude crosses the path from OHTL to a cable. What happens when the reverse occurs i.e. TW travels from a cable to an OHTL?

b) An OHTL has a surge impedance of 400 Ω. A surge voltage of $V= 250(e^{-0.05t}-e^{-t})$ kV where t is in μs travels along the line. The termination of the line is connected to 2 parallel OHTL transformer feeders. The surge impedance of each feeder is 300 Ω. The Xmers are protected by surge diverters. Each of surge diverter impedance is 50 Ω. Determine the max. voltage which would initially appear across the feeder & winding of each Xmer due to the surge. Assume the Xmer to have infinite surge.

c) Generation Company owns 3 generation units that have the following cost functions:

Unit A: $15+1.4\,P_A+0.04\,P_A^2$ Rs/hr

Unit B: $25+1.6\,P_B+0.05\,P_B^2$ Rs/hr

Unit C: $20+1.8\,P_C+0.02\,P_C^2$ Rs/hr

How should these units be dispatched if Generation Company must supply a load of 350 MW at minimum cost?