Seat No.: _____ **Enrolment No._____**

GUJARAT TECHNOLOGICAL UNIVERSITY

BE SEM-VII Examination-Nov/Dec.-2011

Subject code: 170807 **Date: 29/11/2011**

Subject Name: Power System Analysis

Time: 10.30 am-01.00 pm **Total marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** What is per unit system? Write down steps to prepare per unit impedance diagram of given power system. **07**

(b) Prove that per unit impedance of transformer is the same whether computed from primary or secondary side. Draw per unit equivalent circuit of single-phase transformer. **07**

Q.2 **(a)** Draw the waveforms for fault current for a 3-phase fault on alternator terminals. Explain the sub-transient, transient and steady state reactance. What is their significance in fault calculations? **07**

(b) Suppose that a three-bus power system has the subtransient bus impedance matrix given below, and that the power system is initially unloaded with a pre-fault bus voltage of 0.98 p.u. Assume that a symmetrical three-phase fault occurs at Bus 1, and find: **07**

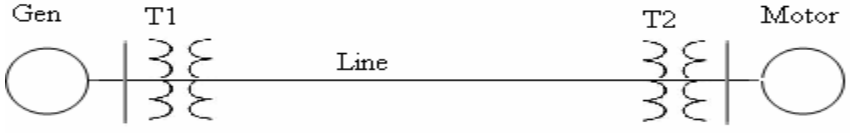
(i) The current flowing in the transmission line from Bus 2 to Bus 1 during the subtransient period.

(ii) The current flowing in the transmission line from Bus 3 to Bus 1 during the subtransient period.

$$Z_{bus} = \begin{bmatrix} j0.20 & j0.10 & j0.15 \\ j0.10 & j0.50 & j0.30 \\ j0.15 & j0.30 & j0.80 \end{bmatrix} \text{ per unit}$$

OR

(b) A synchronous generator and a synchronous motor each rated 25 MVA, 11 kV having 15 % subtransient reactance are connected through transformers and a line as shown in figure. The transformers are rated 25 MVA, 11/66 kV and 66/11 kV with leakage reactance of 10% each. The line has a reactance of 10% on a base of 25 MVA, 66 kV. The motor is drawing 15 MW at 0.8 power factor leading and a terminal voltage of 10.6 kV when a symmetrical three-phase fault occurs at the motor terminals. Find the subtransient current in the generator, motor and fault. **07**



one-line diagram for the system of example

Q.3 **(a)** What do you understand by sequence networks? What is their importance in unsymmetrical fault analysis? **07**

(b) Suppose that a certain unsymmetrical condition gives the following data at the fault point F. **07**

$V_F = 1\angle 0^o$, $I_{a1}Z_1 = 0.2\angle 0^o$, $I_{a2}Z_2 = 0.2\angle 0^o$, $I_{a0}Z_0 = 0.6\angle 0^o$

Find the phase and line-to-line voltage at fault point F.

OR

Q.3 **(a)** Derive fault current equation $I_b = -j\sqrt{3}E_a/(Z_1 + Z_2 + Z^f)$ of line-to-line fault by symmetrical component method. Draw the connection of sequence networks for a line-to-line fault. **07**

(b) A 25 MVA, 13.2 kV alternator with solidly grounded neutral has a subtransient (positive sequence) reactance of 0.25 p.u. the negative and zero sequence reactances are 0.35 and 0.1 p.u. respectively. A singe line to ground fault occurs at the terminals of an unloaded alternator; determine the fault current and line-to-line voltages. Neglect resistance. Draw interconnection of sequence network. **07**

Q.4 **(a)** Explain importance of load flow studies and discuss bus classification in brief for load flow problem. **07**

(b) Figure shows the one-line diagram of a simple four-bus system. Table gives the line impedances identified by the buses on which these terminate. The shunt admittance at all the buses is assumed negligible. **07**

(a) Find Y_{BUS} assuming that the line shown dotted is not connected.

(b) What modifications need to be carried out in Y_{BUS} if the line shown dotted is connected?

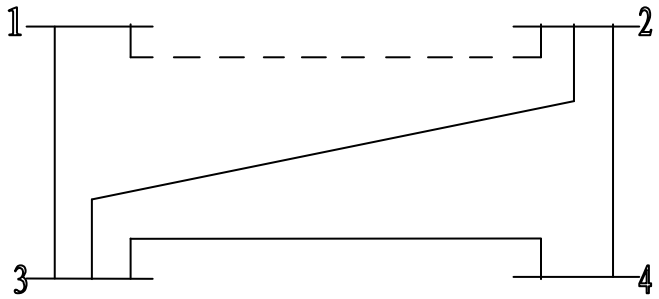


Figure: sample bus system

Line, bus to bus	R, pu	X, pu
1-2	0.05	0.15
1-3	0.10	0.30
2-3	0.15	0.45
2-4	0.10	0.30
3-4	0.05	0.15

OR

Q.4 **(a)** Discuss the advantages and limitations of Gauss-Seidal and Newton Raphson methods. Of this two, which method is generally preferred for solving the load flow problem? **07**

(b) Explain the reclosure case of equal area criterion. Showing the critical clearing angle (δcr) and angle of reclosure (δrc) when fault in middle of a line of the system. **07**

Q.5 **(a)** Describe the traditional technique and new approaches for improvement of transient stability limit of a power system. **07**

(b) What are the conditions to be satisfied before a 3-phase alternator is synchronized to infinite bus bars? **07**

OR

Q.5 **(a)** Discuss the effect of speed-load characteristics of the prime movers on the load sharing of two alternators connected in parallel. **07**

(b) Two alternators, working in parallel, supply the following loads: **07**
(i) lighting load of 800 kW
(ii) 800 kW at power factor 0.9 lagging.
(iii) 500 kW at power factor 0.8 lagging
(iv) 500 kW at power factor 0.8 leading
One alternator is supplying 1000 kW at 0.95 power factor lagging. Calculate the kW output and power factor of the second machine.

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