Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII • EXAMINATION – SUMMER • 2014

Subject Code: 170807 Date: 31-05-2014

Subject Name: Power System Analysis

Time: 02:30 pm - 05:00 pm Total Marks: 70

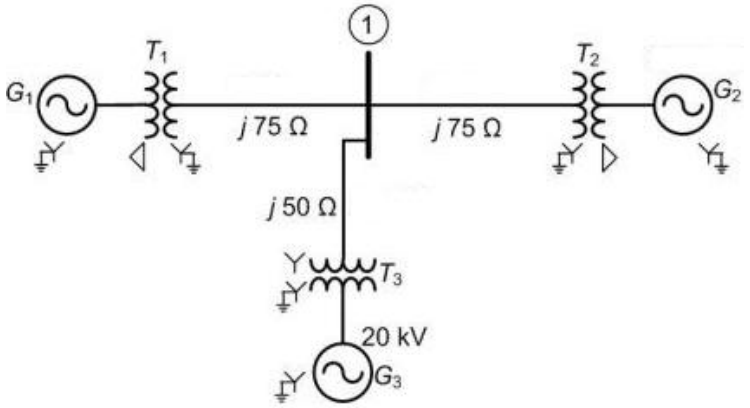
Instructions:

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

Q.1 **(a)** Give the merits and demerits of per unit system. Prove that the per-unit impedance of a transformer is the same regardless of the side from which it is viewed. **07**

(b) Consider the 50 Hz power system the single-line diagram of which is shown in Figure. The system ratings are: **07**

Generator G_1: 200 MVA, 20 kV, X_d = 15%
Generator G_2: 300 MVA, 18 kV, X_d = 20%
Generator G_3: 300 MVA, 20 kV, X_d = 20%
Transformer T_1: 300 MVA, 220Y/22 kV, X = 10%
Transformer T_2: Three single-phase units each rated 100 MVA, 130Y/25 kV, X = 10%
Transformer T_3: 300 MVA, 220/22 kV, X = 10%
The transmission line reactances are as indicated in the figure. Draw the reactance diagram choosing the Generator 3 circuit as the base.



Q.2 **(a)** With the simplifying assumptions explain the SC transient on a transmission line and hence prove that; I_{mm} (max. possible) = $2[\sqrt{2}V/|z|]$, i.e. doubling effect. Also draw necessary waveforms to explain doubling effect. **07**

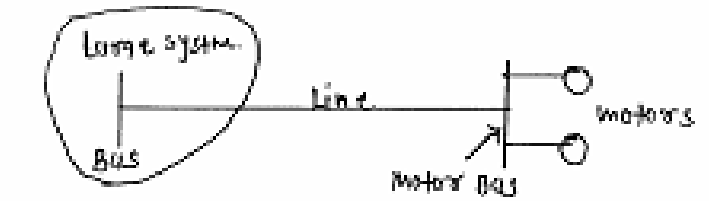
(b) Explain different types of current limiting reactors. Show how they are connected at power stations. Write their uses also. **07**

OR

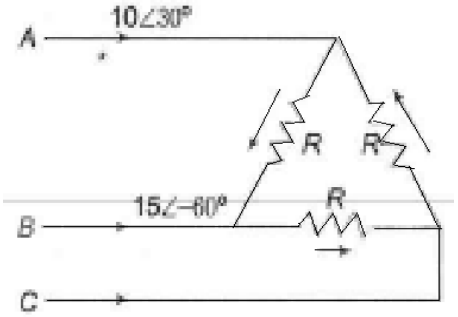
(b) Explain how an unbalanced set of three phase voltages can be represented by systems of balanced voltages. **07**

Q.3 **(a)** Two synchronous motor are connected to the bus of a large system through a short transmission line as shown in figure. the rating of components are : **07**

Motors (each): 1 MVA, 440 V, 0.1 p.u. transient reactance.
Line: 0.05 ohm reactance.
Large system: short circuit MVA at its bus at 440 V is 8.
when the motors are operating at 440 V, calculate the short circuit symmetrical current fed into a 3-phase fault at motor bus.



(b) A delta connected balanced resistive load is connected across an un balanced three phase supply as shown in figure. With currents line A and B specified. Find the symmetrical components of line currents. **07**



OR

Q.3 **(a)** What are the causes of unsymmetrical faults in power system? Derive an expression for the fault current for a single line-to-ground fault. **07**

(b) Justify the following statement: **07**
"For a fault at alternator terminals, a single line to ground fault is generally more severe than a 3-ph fault whereas for faults on transmission lines, a 3-ph fault is more severe than other faults."

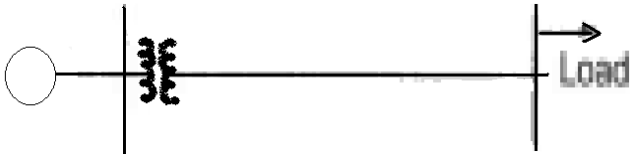
Q.4 **(a)** Derive the power angle equation: $P = (E_G E_M/X) \sin\delta$ with usual notations. Also draw the power angle curve. **07**

(b) A synchronous generator of reactance 1.20p.u. is connected to an infinite bus ($|V|$ = 1p.u.) through transformers and a line of total reactance of 0.60p.u. The generator no load voltage is 1.20p.u. and is inertia constant is H = 4 MW-s/MVA. The resistance and machine damping may be assumed negligible. The system frequency is 50 Hz. Calculate the frequency of natural oscillations if the generator is loaded to (i) 50% and (ii) 80% of its maximum power limit. **07**

OR

Q.4 **(a)** Derive the equation $Y_{bus} = A^t Y A$, Where Y_{bus} = bus admittance matrix, A = bus incidence matrix, A^t = transpose of A and Y = primitive admittance matrix. **07**

(b) For the system of figure. Find the voltage at the receiving bus at the end of the first iteration. Load is 2 + j0.8 p.u. Voltage at the sending end (slack) is 1 + j0 p.u. Line admittance is 1.0 - j4.0 p.u. Transformer reactance is j0.4 p.u. Off-nominal turns ratio is l/l.04. Use the GS technique. Assume $V_R = 1 \angle 0°$. **07**



Q.5 **(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) What are the conditions to be satisfied before a 3-phase alternator is synchronized to infinite bus bars? **07**

OR

Q.5 **(a)** Explain how the active and reactive power loading of an alternator working on infinite bus-bar is controlled. **07**

(b) Describe briefly the principle of operation of load dispatch organization coordinating different types of power plants in a power system. **07**

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