## **GUJARAT TECHNOLOGICAL UNIVERSITY BE - SEMESTER-VII • EXAMINATION – SUMMER • 2014**

Subject Code: 170807

**Subject Name: Power System Analysis** 

Time: 02:30 pm - 05:00 pm

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 07 impedance of a transformer is the same regardless of the side from which it is viewed.
  - (b) Consider the 50 Hz power system the single-line diagram of which is 07 shown in Figure. The system ratings are:

Generator G<sub>1</sub>: 200 MVA, 20 kV,  $X_d = 15\%$ 

Generator G<sub>2</sub>: 300 MVA, 18 kV,  $X_d = 20\%$ 

Generator G<sub>3</sub>: 300 MVA, 20 kV,  $X_d = 20\%$ 

Transformer T<sub>1</sub>: 300 MVA, 220Y/22 kV, X = 10%

Transformer T<sub>2</sub>: Three single-phase units each rated 100 MVA, 130Y/25 kV, X = 10%

Transformer T<sub>3</sub>: 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 07 transmission line and hence prove that;  $I_{mm}$  (max. possible) =  $2[\sqrt{2V/|z|}]$ , i.e. doubling effect. Also draw necessary waveforms to explain doubling effect.
  - (b) Explain different types of current limiting reactors. Show how they are 07 connected at power stations. Write their uses also.

## OR

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

Date: 31-05-2014

**Total Marks: 70** 

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

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 07 balanced three phase supply as shown in figure. With currents line A and B specified. Find the symmetrical components of line currents.



- Q.3 (a) What are the causes of unsymmetrical faults in power system? Derive an 07 expression for the fault current for a single line-to-ground fault.
  - (b) Justify the following statement:"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 07 notations. Also draw the power angle curve.
  - (b) A synchronous generator of reactance 1.20p.u. is connected to an infinite **07** 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.

## OR

**Q.4** (a) Derive the equation  $Y_{bus} = A^tYA$ , Where  $Y_{bus} = bus$  admittance matrix, **07** 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 07 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 1/1.04. Use the GS technique. Assume  $V_R = 1 \perp 0^\circ$ .



- Q.5 (a) Discuss the advantages and limitations of Gauss-Seidal and Newton 07 Raphson methods. Of this two, which method is generally preferred for solving the load flow problem?
  - (b) What are the conditions to be satisfied before a 3-phase alternator is 07 synchronized to infinite bus bars?

OR

- Q.5 (a) Explain how the active and reactive power loading of an alternator 07 working on infinite bus-bar is controlled.
  - (b) Describe briefly the principle of operation of load dispatch organization 07 coordinating different types of power plants in a power system.

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