Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

B. E. Sem. - V - Examination – June- 2011

Subject code: 150902

Subject Name: Power System Analysis and Simulation

Date:22/06/2011 **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)** Consider a 230 mile long 60 Hz transmission line. Its series impedance z is 0.1603 + j8277 Ω/mile and shunt admittance y is j5.105 X 10^{-6} mho/mile. The load on the line is 125 MW at 215 kV with unity power factor. Find the voltage, current and power at the sending end and the voltage regulation of the line. Also find the wavelength and velocity of propagation in miles and miles/s respectively. Please consider the line as a long line. **07**

(b) Using A, B, C and D constants of transmission line, V_R as reference phasor and with other usual notations, derive expressions of active powers and reactive powers at both ends. Write expression of maximum power that can be transmitted at the receiving end. **07**

Q.2 **(a)** A delta connected balanced resistive load is connected across an unbalanced three-phase supply. The currents in lines A and B are $10\angle 30^o$ and $15\angle -60^o$ respectively. Find current in line C. Find symmetrical components of phase currents flowing in the individual resistances of the delta connected load. **07**

(b) Write a brief note on phase shift of symmetrical components in Y-Δ transformer banks. **07**

OR

(b) Write a note on zero sequence networks in brief. **07**

Q.3 **(a)** Explain single line to ground fault on an unloaded generator using symmetrical components. Draw connection of sequence networks. **07**

(b) A salient-pole generator without dampers is rated 20 MVA, 13.8 kV and has a direct-axis subtransient reactance of 0.25 pu. The negative- and zero–sequence reactances are 0.35 pu and 0.1 pu respectively. The neutral of the generator is solidly grounded. Determine the subtransient currents and the line-to-line voltages at the fault under subtransient conditions when a line-to-line fault occurs at the b and c terminals of the generator. Assume that the generator is unloaded and operating at rated terminal voltage when the fault occurs. Neglect resistance. **07**

OR

Q.3 **(a)** A 300 MVA, 20 kV three-phase generator has a subtransient reactance of 20 %. The generator supplies two synchronous motors rated 13.2 kV, over a 64 km transmission line having transformers at both ends. The neutral of motor M_1 is grounded through reactance and the neutral of motor M_2 is not grounded as shown in Figure 1. Rated inputs to the motors are 200 MVA and 100 MVA for M_1 and M_2 respectively. For both motors the subtransient reactance is 20 %. **08**

The three phase transformer connected at sending end, T_1, is rated 350 MVA, 230/20 kV with leakage reactance of 10 %. Transformer T_2 is connected at receiving end and is composed of three single phase transformers each rated 127/13.2 kV, 100 MVA with leakage reactance of 10 %. Series reactance of transmission line is 0.5 Ω/km. Draw the reactance diagram with all reactances marked in per unit. Select the generator rating as base in the generator circuit.

(b) Explain one-line diagram in brief. Write advantages of per unit system. **06**

Q.4 **(a)** Derive expressions of voltage phasor and current phasor at any point of a long transmission line as function of distance ***x*** from receiving end in terms of distributed parameters of the line, voltage phasor V_R (voltage at receiving end) and current phasor I_R (current at receiving end). State difference between characteristic impedance and surge impedance of the line. **08**

(b) Derive equivalent- π circuit of a long transmission line using the expressions derived in above question. **06**

OR

Q.4 **(a)** Explain travelling waves of a transmission line when the receiving end is short circuited. **07**

(b) Write a brief note on capacitance switching. **07**

Q.5 **(a)** Describe how one can obtain symmetrical components of a given set of unbalanced three phasors of a three phase system. State in which direction the set of negative sequence phasors rotates as time increases. State the frequency of zero sequence phasors. Describe the applications of symmetrical components. **08**

(b) Write a brief note on selection of circuit breakers. **06**

OR

Q.5 **(a)** Explain need of neutral grounding using phasor diagrams. Explain any one method of neutral grounding. **07**

(b) Describe the phenomena of corona in brief. State and explain any three factors affecting corona. **07**

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Figure 1 (Q.3 OR (a))