Roll No.:								

B.E. / B.Tech. (Full Time) DEGREE END SEMESTER EXAMINATIONS, April / May 2013

ELECTRICAL & ELECTRONICS ENGINEERING BRANCH

SEVENTH SEMESTER

EE 9039 – ADVANCED POWER SYSTEM ANALYSIS

(REGULATIONS 2008)

Time: 3 hr Max. Marks: 100

Answer ALL Questions

PART-A (10 X 2 = 20 Marks)

1. What is the need for LU factorization?
2. What is the significance of synchronizing power coefficient ?
3. Give expressions for P and Q of exponential loads
4. How to obtain the critical clearing time by time-domain simulation?
5. What is meant by Loadability limit?
6. What is the effect of shunt compensation on maximum deliverable power?
7. A turbine-generator unit is connected to an infinite bus through a step-up transformer and a transmission line. Fifteen percent of the total reactance (sub-transient reactance of the generator plus the reactances of the transmission line and transformer) is compensated by a series capacitor. If the nominal system frequency is 50 Hz, what is the natural frequency of induced currents in the rotor of the generator for a disturbance near the infinite bus?
8. What is the need for voltage dependent current order limiter in HVDC link?
9. What is the need for FACTS controllers?
10. How many system mode and torsional modes of oscillation can occur in a turbine-generator with six rotating masses?

PART-B (5 X 16 = 80 Marks)

11a. (i)Derive the Fast Decoupled Power flow model from the N-R power flow model. State the assumptions that are considered. (8)

(ii) Draw the flow chart for obtaining the power flow solution by Fast Decoupled Method. (8)

12(a) The synchronous machine shown in Fig. Q12a is generating 200 MW and 125 MVAR. The voltage of bus q is 1+j0 pu. The generator is connected to the infinite bus through a line of reactance 0.06 p.u. on a 100 MVA base. The machine transient reactance is 0.2

pu and the inertia constant is 5 pu on a 100 MVA base. The frequency of the supply is 60Hz. For the damping torque coefficient k_D of 5 and -5 determine

(i) Eigen values (6)

(ii) Undamped and damped frequency of rotor oscillations and damping ratio (4)

(iii) Right and Left eigen vectors (6)

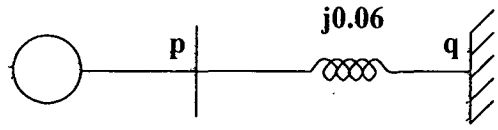

Fig. Q12a

(Or)

12(b). Describe stepwise computations involved in interfacing a classical model of a synchronous machine with the transient stability algorithm based on implicit integration method to advance simulation from time "t-Δt" to time "t." (16)

13(a). Derive the condition for maximum deliverable power of a single load infinite bus system under the following conditions: (i) unconstrained load power factor (ii) under a given load power factor and (iii) using power flow equations. (16)

(Or)

13(b). Four identical unity power factor conductance loads used for space heating are controlled by a thermostat. Each load is capable of achieving an active power consumption of 1.0 pu at 1.0 pu voltage. The initial weather conditions are such that only two loads are required to maintain the set temperature. The load duty cycles are such that only two loads are "on" at any given time. The initial duty cycle is such that each load is "on" for four minutes and "off " for four minutes. The initial power consumed by the loads are as follows: P1= 1.0 pu for 0 to 2 min; P2 = 1.0 pu for 0 to 4 min; load nos.3 and 4 start at 2 min and 4 min. respectively. A sudden voltage reduction takes place at time = 6 min. from 1.0 pu to 0.894 pu. Assuming that the thermostat restores the average power consumed by each load, sketch the duty cycle of each load and the total load giving appropriate values for the power and the time instants at which the power changes for up to 20 min. Assume that the "off" period of the duty cycle remains unaltered after the voltage reduction. (16)

14(a) The mechanical system of a steam turbine unit consists of 4 masses that correspond to the generator (mass no.1), LP, IP and HP (mass no.4) respectively. The torques of the

turbine stages are given by T_{HP}, T_{IP}, and T_{LP}. The opposing electromagnetic torque of the generator is given by T_e. Derive the expression for the dynamics of the shaft system in the standard state variable canonical form $p\boldsymbol{x} = \boldsymbol{Ax} + \boldsymbol{Bu}$. The state variables are the speeds and angular positions of the masses with respect to a common reference. (16)

(Or)

14(b) (i). Explain how self-excitation can occur in a generator connected to a series-compensated transmission line. (4)

(ii) Explain about the torsional interaction with Generation Excitation control. (4)

(ii). Discuss the various counter measures to SSR problems. (8)

15(a). Explain about the control of HVDC link with the necessary equations and diagrams. (16)

(Or)

15(b) Show that with SVC transient stability margin can be improved by enhancing synchronising torque. Derive the necessary equations. (16)