M.E. 2nd Semester (EE) Final Examination 2012
Power System Stability
EE 1017

Time: 3 hrs Full Marks: 70

Answer SIX questions taking any four from Section A and any two from Section B
Two marks reserved in each half for neatness.

Section A

1. a) What is load bus reactive power sensitivity? What is its implication on voltage stability? (4)
b) Derive an expression for reactive power requirement for control of voltage in long lines. (3)
c) Examine the effect of adjustment in generator excitation and transformer tap changing on voltage stable state of a power system. (4)

2. a) What are the salient disturbances that cause voltage instability? (3)
b) Develop the real and reactive power operating contour of a radial power transmission system. (4)
c) What is voltage security? Explain its implications on power system operation. (4)

3. Develop the necessary mathematical expressions of a voltage stability indicator using the concept of FVSI and LQF for two bus line model. State the assumptions. (11)

4. a) Explain the concept of reduced jacobian in modal analysis for voltage stability computations in power system? What is V-Q sensitivity? (8)
b) Explain briefly the concept of voltage stability margin. (3)

5. a) What are the devices used in active compensation of power system? Briefly explain the operation of the voltage source inverter based STATCOM device. (8)
b) Why STATCOM is better than an equivalent FCTCR SVC from the view point of compensation in power system. (3)

6. Develop the steps of computer algorithm for multi machines stability of a power system. (11)

Section-B

1. (a) Derive the equation of motion of the rotor of a synchronous machine.

   (b) A 50 Hz, 100 MVA, four pole, synchronous generator has an inertia constant of 3.5 s and is supplying 0.16 pu power on a system base of 500 MVA. The input to the generator is increased to 0.8 pu. Determine (i) the kinetic energy stored in the moving parts of the generator and (ii) the acceleration factor of the generator. If the acceleration continues for 7.5 cycles, calculate (iii) the change in rotor angle and (iv) the speed in rpm at the end of the acceleration. [5+6]

2. (a) Derive the expression for steady state stability of an uncontrolled system with and without damping factors.

   (b) A two pole, 50 MVA, 11kV generator is supplying full load at 0.8 power factor lagging. If the inertia constant of the moving parts of the generator is 6.0 MJ/MVA, calculate the energy stored when the generator is running at the synchronous speed of 3000 rpm. If the net input to the generator is suddenly increased to 62000 metric HP, calculate the acceleration produced. [5+6]

3. (a) Define self oscillation.

   (b) Derive the characteristics equation by using a damping factor α occurred in the system.

   (c) Draw the graph for the different types of system stability. [3+4+4]