M.E. 2nd Semester (EE) Final Examination 2013

Power System Stability

EE 1017

Time: 3 hrs   Full Marks: 70

Answer FIVE questions taking any TWO from First Half and any THREE from Second Half

First Half

1(a)Define stability of a power system. Classify them.

(b)Prove that the reactance , inside the alternator during the fault condition are varying in nature.   [6+8]

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.   [7+7]

3(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.   [7+7]

4(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+7]

Second Half

(Answer any three Questions)

5. a) Show that voltage regulation of a power transmission line is very much sensitive to reactive power demand and transfer reactance of the line. [7]

b) What is load bus reactive power sensitivity? How can you obtain this value from the Jacobian of load flow equations? [7]

6. a) Briefly explain the concept of voltage stability and the implication of the profile of incremental change in load bus voltage to incremental change in reactive power demand at that load bus. [7]

b) What are the types of compensating devices in an EHVAC power transmission system? How does a static VAR compensator perform this function? [7]

7. a) What is voltage security? [3]

b) Derive the expression for critical receiving end bus voltage and critical power angle at voltage stability limit of a basic two bus power line model. [11]

8. a) Analytically establish the concept of a load voltage indicator in assessing voltage stability of a power system. [7]

b) How do you take the help of the concept of singular value decomposition is obtaining the saddle node bifurcation point for voltage stability limit? [7]

9. Derive an expression for the fast voltage security index and line quality factor. How does it provide voltage security factor for an EHV power line? [14]

10. a) Establish a relationship between voltage stability and the off nominal tap ratio of load side transformer and source to load reactance. [10]

b) What is multi-machine stability? What are the implications of study of multi-machine stability problem? [4]