M.E. (EE) 2nd Semester Final Examination,2014

Power System Stability

EE 1017

Full Marks: 70

Time= 3Hrs.

Answer any three questions from Group A and any two questions from group B.

Group A

1. (a) In a two bus power system the sending end voltage (E) is 1.00 pu while the uncontrolled receiving end bus voltage (V) is 0.95pu. Assume the power angle (δ) to be 30^0. Show that the transmission line connecting these two buses "demands' reactive power from the system if this transmission line has inductive reactance (X) of 0.1pu. [6]

(b) Briefly explain how (dV/dQ) at a voltage uncontrolled load bus indicates the voltage stability condition in a multibus system. How do you obtain the degree of stability with such an indicator? [5]

(c) Analytically show that the changes in series reactive loss increases sharply with any drop in transmission voltage. [3]

2. (a) Obtain the expression of receiving end voltage of a two bus voltage uncontrolled system at voltage stability limit of a power system. Assume sending end voltage to be constant. [10]

(b) Find the expression of the critical power angle at voltage stability limit. [4]

3. (a) Analytically compare between shunt and series passive reactive power compensators connected at a load bus of a network. [7]

(b) Briefly state the operation of a FCTCR type of SVC. How do you model such a SVC in voltage stability simulation study? [7]

4. a) Find the expression of Fast Voltage Stability Indicator (FVSI) and Line Quality Factor (LQF) for a two bus power system. [7]

b) How do obtain the voltage security factor (VSF) in voltage security analysis study? [3]

© Find the simple expression of load voltage indicator for voltage stability. [4]

5. (a) Briefly describe the operation of a STATCOM and develop the power flow model of it. [8]

(b) State how would you obtain the expressions of real power for multi-machine stability study in case of transient operations following short circuit fault in the power system followed by breaker clearance. [6]

Group B

6. (a) Define stability, steady state stability and dynamic stability.Develop the swing equation for generator connected to power system network. [6]

(b) A 50 Hz, 100MVA, 4 pole, and synchronous generator has an inertia constant of 3.5 sec. and supplying 0.16pu power on a system base of 500MVA .The input of the generator is increased to 0.8pu.Determine [8]

I. The kinetic energy stored in the moving parts of the generator

II. The acceleration factor of the generator if the acceleration continues for 7.5 cycles.

III. Calculate the change in rotor angle and

IV. The speed in rpm at the end of the acceleration.

7. (a) Develop the equal area criterion for stability analysis. [4]

(b) A 50Hz synchronous generator is supplying 0.8pu real power at 0.8 lagging power factor to an infinite bus via a transmission line whose reactance is 0.4pu.If the direct axis transient reactance of the generator is0.2pu and the inertia constant H=10MJ/MVA, Determine [10]

I. The steady state power limit

II. Synchronous power co-efficient

III. The frequency of free oscillation and

IV. The time period of free oscillations. Assume the infinite bus voltage equal to 1.0+j0

8. (a) Derive the expression for steady state stability of an uncontrolled system with and without damping factors. [6]

(b) A 2 pole, 50 MVA, 11kV generator is supplying full load at 0.8 power factor lagging. If inertia constant of the moving parts of the generator is 6.0MJ/MVA calculate the energy stored when the generator is running at the synchronous speed of 3000rpm.If the net input to the generator is increased to 62000metric HP, calculate the acceleration produced. [8]