Exam.Code:1018
Sub. Code: 35256

2055

M.E. Electrical Engineering (Power Systems)

Second Semester

EE-8201 (PS): Power Systems Dynamics and Stability

Time allowed: 3 Hours Max. Marks: 50

NOTE: *Attempt any five questions.*

x-x-x

I. Define voltage stability and distinguish between voltage stability and angle stability. Explain the conditions that lead to voltage collapse in a power system. 10

II. Using equal area criterion, determine the critical clearing angle for a generator supplying power to an infinite bus through a transmission line, subjected to a three-phase fault at the midpoint of the line. Draw necessary power-angle curves, clearly show pre-fault, during-fault, and post-fault conditions. 10

III. Compare and contrast small signal stability and transient stability. How do machine and network parameters influence these stabilities? Provide practical examples and mention methods to improve each type of stability. 10

IV. Explain the phenomenon of transient stability in power systems. Derive the swing equation and discuss its application in determining the transient stability of a system. Highlight the assumptions involved and show how system parameters affect stability. 10

V. A synchronous generator is delivering power to an infinite bus through a transmission line. A three-phase fault occurs and is cleared after 0.2 seconds. Using the swing equation, determine whether the system remains stable. Use assumed or given parameters and show numerical steps involved. 10

VI. Describe the concept of eigenvalue analysis in the context of small signal stability. How do system modes and participation factors help identify critical components in a multimachine power system? 10

VII. A generator in an SMIB system is delivering 1.0 pu power to an infinite bus at an initial power angle of $\delta_0 = 25°$. A three-phase fault occurs and is cleared after 0.1 seconds. The system parameters are: 10

- $H = 6$ MJ/MVA
- System frequency $f = 50$ Hz
- During-fault accelerating power $P_a = 0.6$ pu

(a) Apply the step-by-step Euler's method to solve the swing equation for the first two time steps with a step size of 0.05 seconds.

(b) Determine whether the rotor angle is accelerating or decelerating after fault clearing.

P.T.O.

VIII. A simple two-bus power system consists of a slack bus (Bus 1) and a load bus (Bus 2) connected through a transmission line with impedance $Z = 0.1 + j0.5$ pu. The voltage at Bus 1 is maintained at $|V_1| = 1.0$ pu. The load at Bus 2 is modeled as a constant power load drawing $P_L = 0.9$ pu. 10

(a) Calculate the voltage at Bus 2 using the power flow equation (you may assume a flat start for iteration).

(b) Determine the maximum load $P_{L,\max}$ that can be supplied to Bus 2 without causing voltage collapse. Use analytical or graphical (PV curve) methods.

x-x-x