Exam.Code:1018
Sub. Code: 7784

2072

M.E. Electrical Engineering (Power Systems)

Second Semester

EE-8201: Power Systems Dynamics and Stability

Time allowed: 3 Hours

Max. Marks: 50

NOTE: *Attempt <u>any five</u> questions. Missing data (if any) can be appropriately assumed.*

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1.A) Define and explain Voltage Stability of Power System with the help of P -V and Q-V curves. **(05)**

B) A generator is delivering 1.0 pu power to an infinite bus through a network having negligible resistance, at 50Hz. A fault occurs which reduces the maximum power transferable to 0.45 pu, whereas before the fault this power was 1.85 pu and after the clearance of fault it is 1.25 pu., using the equal area criterion, determine the critical clearing angle. **(05)**

2.A) Explain significance of first swing stability of generators. Draw Power -angle curve and explain Equal Area Criterion **(05)**

B) Draw and explain generator capability curve label the diagram indicating various limitations on generation of active and reactive power, and stability limits. **(05)**

3.A) Explain the small signal stability of single machine infinite bus system with classical generator model. Derive all the necessary equations. **(05)**

B) A generator is connected through a transformer and a parallel transmission line to an infinite bus bar. The machine is delivering 1.0 per unit power and both the terminal voltage and the infinite bus voltage are 1.0 per unit. Transient reactance of the generator is 0.20 per unit and that of transformer is 0.1 per unit with line reactances of 0.4 per unit each. If fault occurs near the in the middle of the bus bar on one of the lines and circuit breaker operates, find the new operating point using equal area criterion. **(05)**

4. Generator: 500 MVA, 450 MW, 22kV, 50 HZ, $R_a = 0.0024$, $X_d = 2.67$, $X_q = 2.35$, $X_d' = 0.253$, $H = 2.87$ MWs/MVA. Step up Transformer: leakage reactance = j0.25.

Transmission line: $X_{pos} = j1.0$ per circuit. All reactance are in p.u on 500 MVA.

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Initial operating condition: active power output of the generator P =0.85pu. Reactive power output Q= 0.52p.u (lagging). Terminal voltage of generator V_t= 1.0 p.u. All resistances, shunts including half line charging and series impedance between double circuit transmission line and infinite bus are ignored. This assumption yields external impedance value as 0 + j0.65 p.u.

(i) Write the Linearized state equations of the system.

(ii)Determine the Eigen values, damped frequency of oscillator in HZ, damping ratio and undamped natural frequency for K_D =10 (10)

5.(A) Deduce the swing equation as used to describe the transient stability of the system. Hence develop the transient energy function and explain stability concept using this approach. **(05)**

(B) What is multi machine stability problem? Hence, develop a reduced order model for stability analysis of the multi machine system when there is LG fault on one of the machine. **(05)**

6.A) How is static and dynamic load modeling done for stability studies? Hence explain the effect of thermostatically controlled load on stability. **(05)**

B) Briefly explain the single-machine infinite bus (SMIB) configuration. **(05)**

7.A) Briefly explain the effects of field circuit dynamics in small signal stability analysis. **(05)**

B) Discuss the effect of the excitation system on the stability of the system. Hence, develop a complete state-space model for the power system including excitation system and represent the same in the block diagram with exciter and AVR. **(05)**

8.A) Develop and explain an IEEE type DC1A exciter system model with the help of suitable block diagram. Also explain how does an excitation system affect the dynamics of a system? **(05)**

B) How voltage stability is assessed using sensitivity analysis. Develop a state space model for it and comment upon the stability. **(05)**

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