CBCS SCHEME

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16/17EPS13

# First Semester M.Tech. Degree Examination, June/July 2019
# Power System Dynamics (Stability and Control)

Time: 3 hrs. Max. Marks: 80

***Note: Answer any FIVE full questions, choosing ONE full question from each module.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

## Module-1

1 a. Obtain the steady state stability analysis of a single machine connected to infinite bus and derive necessary conditions for stability also sketch the root loci of eigen values. **(08 Marks)**

b. A single Machine connected to a load centre through a transmission line as shown in Fig.Q.1(b). The load centre is represented by a reactance connected to infinite bus. The generator is initially operating with $P_e$ = 1.0 p.u. and the magnitude of voltages $V_1 = V_2 = 1.0$ p.u. Find the maximum step increase in mechanical power that will not cause transient in stability. Use equal area criterion.
Assume $x_g = 0.3$, $x_t = 0.1$, $x = 0.4$, $x_2 = 0.1$. **(08 Marks)**

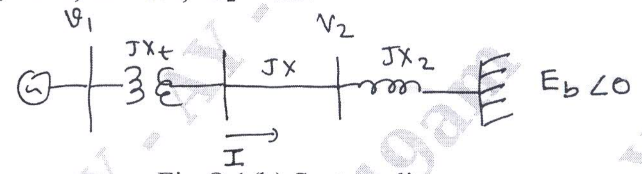


Fig.Q.1(b) System diagram

**OR**

2 a. With the help of block diagram explain the states of operation of power system, also discuss the system dynamic problems in context with current status and recent trends. **(08 Marks)**

b. With the help of neat sketch draw the model of synchronous machine (schematic diagram) derive flux linkage equations, voltage equations and torque equation. **(08 Marks)**

## Module-2

3 a. Draw and explain the d-axis and q-axis equivalent circuits of a synchronous machine. **(08 Marks)**

b. Discuss in detail transient analysis of a synchronous machine connected to the voltage source. **(08 Marks)**

**OR**

4 a. With the help of functional block diagram, discuss in detail DC excitation systems. **(08 Marks)**

b. A generator is driven by a hydroturbine and is delivering a constant power load. The governor input $\Delta \bar{w}$ is determined from the differential equation:

$$2H\frac{d\bar{w}}{dt} = P_m - P_e$$

The overall system representation (neglecting limits) including the governor turbine and rotor is shown in Fig.Q.4(b). The permanent speed drop is neglected in modeling the governor. For the system to be stable show that

$$\beta < \frac{1-1.5\alpha}{1-\alpha} \quad \text{where} \quad \alpha = \frac{T_W}{T_R}, \quad \beta = \frac{T_W}{2\delta H}$$ **(08 Marks)**

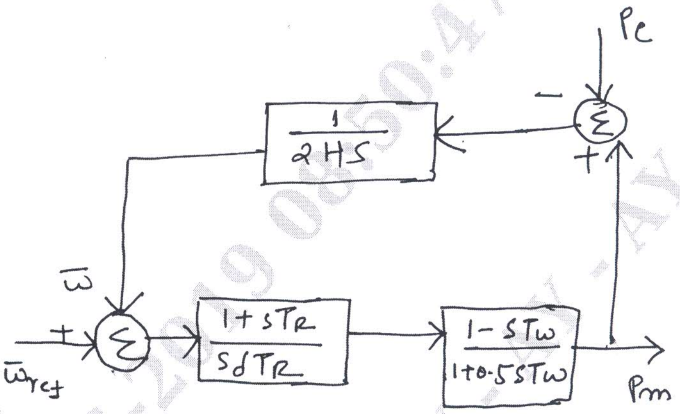


Fig.Q.4(b)

## Module-3

5 a. Discuss in detail the modeling of transmission network. **(08 Marks)**

b. What is the use of static var compensators in power system network? With the help of equivalent circuit and block diagram explain operation of SVC controller. **(08 Marks)**

**OR**

6 a. Prove that, if the armature flux linkage components, with respect to a synchronously rotating reference frame are constants then the transformer esmt terms ($\rho\psi_d$ and $\rho\psi_q$) and terms introduced by variations in rotor cancel each other **(08 Marks)**

b. Discuss in detail the inclusion of SVC model with their regions of operation. **(08 Marks)**

## Module-4

7 a. With the help of overall system block diagram develop characteristic equation and obtain criteria for stability by forming Routh array. **(08 Marks)**

b. Explain the small signal analysis of SMIB system with necessary equations. **(08 Marks)**

**OR**

8 a. Explain the structure of a PSS, with the help of block diagram. **(08 Marks)**

b. With the help of block diagram explain control signals in context of "synthesis of accelerating power signal". Also write the criteria for the choice of control signal for PSS. **(08 Marks)**

## Module-5

9 a. Discuss in detail detailed model Case-I with all necessary equations. **(08 Marks)**

b. Explain inclusion of load and SVC dynamics in detail with relevant matrices. **(08 Marks)**

**OR**

10 Write short note on:

a. Solution methods

b. Formulation of system equations

c. Simultaneous solutions

d. Dynamic equivalent and mode reduction. **(16 Marks)**

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