

4 (a) What are the basic differences between angle and voltage stability? [5]

(b) Describe briefly various types of oscillatory stability in the context of small signal stability in power systems? [5]

(c) The model of a single machine and infinite bus (SMIB) is given by

$$\frac{d\delta}{dt} = (\omega - \omega_s) \quad (4.1)$$

$$M \frac{d\omega}{dt} = P_{mech} - P_{max} \sin \delta - K_D (\omega - \omega_s) \quad (4.2)$$

Using  $P_{mech}$  as input and  $\omega$  as output, obtain a linear state-space model in the standard form  $\dot{X} = AX + Bu$  and  $y = CX + Du$ . Write down the expression for  $A, B, C$  and  $D$  [10]

5 (a) Write short notes on any four of the following:

- |       |   |     |
|-------|---|-----|
| (i)   | Damper winding  | [5] |
| (ii)  | Inter-area oscillations   | [5] |
| (iii) | Eigen-value sensitivities in small signal stability                   | [5] |
| (iv)  | FACTS controllers   | [5] |
| (v)   | Effect of Automatic Voltage Regulator (AVR) on power system stability | [5] |
| (vi)  | Midterm and long term stability                                       | [5] |

- 6 (a) Describe the importance of power system stabilizer (PSS) in small signal stability performance of the system. What are the commonly used input signals to PSS? [8]
- (b) What is governor droop in turbine speed control? Why is it so important to have a large droop setting for governor in hydraulic turbine? [5]
- (c) Fig 6.1 shows the block diagram of a turbine speed control system. The values of  $T_W$ ,  $T_M$  and  $K_D$  are 2.0, 10.0 and 0.0 respectively. Write down the closed-loop transfer function and identify the range of  $R$  that ensures closed-loop stability. [7]

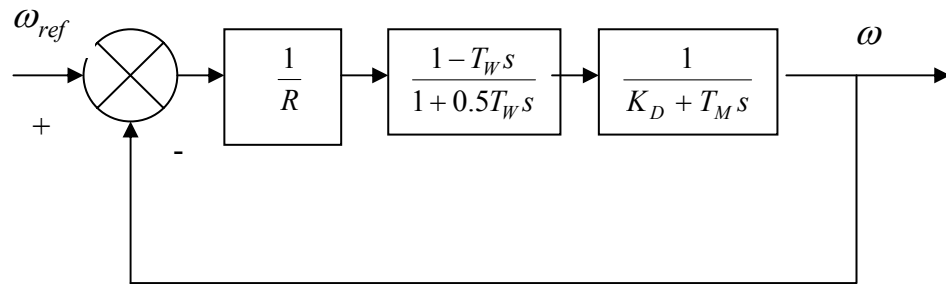


Fig 6.1