(3 Hours) **Total Marks: 80**

N.B.: 1. Question **No.1.**is**compulsory.**

2. Attempt any **three** questions out of the remaining **five** questions.

3. Assume **suitable** data wherever **required.**

4. **Figures** to the **right** indicates **full** marks.

Q1. a. Derive the transfer function of mercury in glass thermometer **[5]**

b. Compare PI and PID control system. **[5]**

c. Differentiate between servo problem and regulatory problem. **[5]**

d. Describe Bode stability criterion. **[5]**

Q2. a. Derive the step response of a first order system **[6]**

b. A thermometer having first order dynamics with a time constant of 1 min is placed in a temperature bath at 100 ^{o}C. After the thermometer reaches steady state, it is suddenly placed in a bath at 110 ^{o}C at t=0 and left there for 1 min, after which it is immediately returned to the bath at 100 ^{o}C. Calculate the thermometer reading at t=0.5 min and at t=2.0 min. **[8]**

c. Compare step response and impulse response of a first order system. **[6]**

Q3 a. Draw the root locus for the system having open loop transfer function as

$$G(s)H(s)=\frac{K}{s(s+4)(s+2)}$$ **[15]**

b. Compare interacting and non-interacting system **[5]**

Q4. a. For a unity feedback system $G(s)=\frac{80}{s(s+2)(s+20)}$ sketch the bode plot and comment on stability **[15]**

b. Draw block diagram of a simple feedback control system with specification of each block **[5]**

Q5. a. Write the working principle and application of radiation pyrometer with neat diagram. **[10]**

b. Derive the transfer function of a two tank interacting system **[10]**

Q6 Write short notes on (any **four**) **[20]**

a. Role of damping coefficient in second order system

b. Cascade control system

c. Routh test for stability analysis

d. Final control element

e. Nyquist stability criteria
