

**BACHELOR OF TECHNOLOGY (C.B.C.S.) (2014 COURSE)**  
**B.Tech.Sem - VII CHEMICAL : WINTER- 2022**  
**SUBJECT : PROCESS DYNAMICS & CONTROL**

Day : Tuesday

Time : 02:30 PM-05:30 PM

Date : 13-12-2022

W-13595-2022

Max. Marks : 60

**N.B.:**

- 1) All questions are **COMPULSORY**.
- 2) Figures to right indicate **FULL** marks.
- 3) Draw neat and labeled diagram **WHEREVER** necessary.
- 4) Use of non-programmable **CALCULATOR** is allowed.
- 5) Assume suitable data if necessary.

- Q.1** Develop the transfer function for a first order system of mercury thermometer [10] exhibiting unsteady state behavior with neat diagram.

**OR**

A thermometer follows first order dynamics with time constant of 0.2 minute. [10] It is placed in a temperature bath of 120 °C and is allowed to reach steady state. It is suddenly transferred to another bath at 180 °C at time t = 0 and is left there for 0.2 minute and immediately returned to the original bath at 120 °C. estimate thermometer reading at t = 0.2 min.

- Q.2** A step change of magnitude 4 is introduced into a system having transfer function given as below. Estimate, overshoot and frequency of oscillation, also comment on nature of damping coefficient. [10]

$$\frac{Y(S)}{X(S)} = \frac{5}{2s^2 + 0.3s + 0.5}$$

**OR**

Elaborate characteristics of under damped system for step change with neat sketch and define terms: [10]

- |                 |                                   |
|-----------------|-----------------------------------|
| i) Overshoot    | iv) Period of oscillation         |
| ii) Decay ratio | v) Response time                  |
| iii) Rise time  | vi) Natural period of oscillation |

- Q.3** A set point of control system having transfer function as below has a step change of 0.1 unit. Determine: [10]

- i) The maximum value of C and the time at which it occurs
- ii) Offset
- iii) Period of oscillation

$$\frac{C(S)}{R(S)} = \frac{8}{2s^2 + 3s + 9}$$

**OR**

Derive an expression for regulator mechanism of proportional derivative controller also give the expression for offset using PD controller with regulator mechanism. [10]

**P.T.O.**

**Q.4** The open loop transfer function of a control system is given as: [10]

$$G(S) = \frac{Kc(s+2)}{s(s+3)(s+4)}$$

Determine the stability of the system using Routh stability criterion.

OR

- a) Enumerate the steps for estimating stability by Routh stability method, also mention the rules of Routh stability. [05]
- b) Elaborate with neat sketch different nature of root loci in process control. [05]

**Q.5** a) Enumerate step wise rules for plotting bode diagrams and elaborate the bode stability criterion. [05]

- b) Elaborate Gain and Phase margin in detail. [05]

OR

Plot the bode diagram for following control system: [10]

$$G(S) = \frac{4(1+2s)e^{-0.5s}}{(s+1)(0.2s+1)}$$

**Q.6** a) Elucidate the Z-N settings for P, PI and PID controller. [05]

- b) Elaborate the significance and working of ratio control in process industry, with an example. [05]

OR

Find the P, PI PID settings for the following system by Z-N method [10]

$$G_p = \frac{1}{(5s+1)(2s+1)}, G_m = \frac{1}{(10s+1)}, G_f = 1$$

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