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 exhibiting unsteady state behavior with neat diagram. **[10]**

OR

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

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
ii) Decay ratio
iii) Rise time
iv) Period of oscillation
v) Response 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]**

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

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