Code No: **R32082** **R10** **Set No. 1**

III B.Tech II Semester Supplementary Examinations, April - 2018

PROCESS DYNAMICS AND CONTROL

(Chemical Engineering)

Time: 3 hours **Max. Marks: 75**

Answer any FIVE Questions

All Questions carry equal marks

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1 a) Derive Laplace transforms for below functions [8M]
i) Step function ii) Exponential function iii) Ramp function iv) Sine function

b) The following data has been given for thermocouple of spherical in shape. [7M]
Thermal conductivity 30 W/m.^{o}C density is given as 8600 kg/m^{3} and specific heat is 04 kJ/kg.^{o}C. The heat transfer coefficient between the gas stream and the junction is 280 W/m^{2}.^{o}C. What will be the time required for the thermocouple to record 80 percent of the applied temperature difference?

2 a) Write in brief about the following [6M]
i) Transportation lag ii) Critically damped system iii) Over-damped system iv) Under damped system.

b) A step change of 8 is introduced into a system with transfer function given below. [9M]

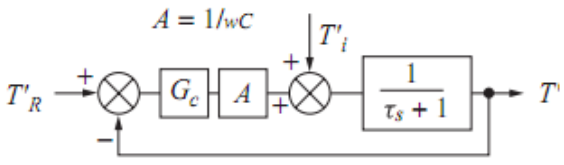
$$\frac{Y(s)}{X(s)} = \frac{25}{5s^2 + 8s + 20}$$

Calculate the following
i) Percent overshoot ii) Rise time iii) Maximum value of Y(t)
iv) Ultimate value of Y(t) v) Period of oscillation

3 a) With a neat sketch, explain the components of a control system. [8M]

b) The set point and process temperature of a PID temperature controller are initially same. The controller is at steady state with an output pressure of 9 psig. At t=0, the set point is increased at the rate of 0.5^{o}F/min. The motion of the set point is in the direction of lower temperatures. If the current settings are [7M]
Kc = 2 psig/^{o}F
τ_i=1.25 min
τ_D=0.4 min
Plot the output pressure versus time.

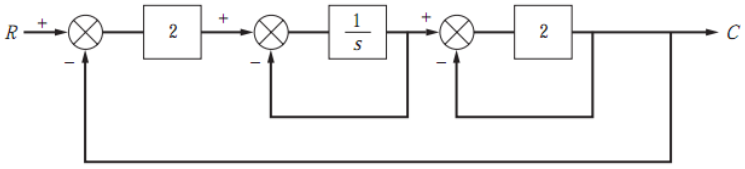
4 a) Derive the transfer function for servo problem for the following block diagram. Assume proportional controller. [8M]



Find out the offset for the above system?

Code No: **R32082** **R10** **Set No. 1**

b) Determine the transfer function of C(s)/R(s) for the control system given below. [7M]



5 a) What is meant by Stable system? Explain stability criteria with the help of any one physical example in chemical engineering. [6M]

b) The open loop transfer function of feedback control system has been given below [9M]

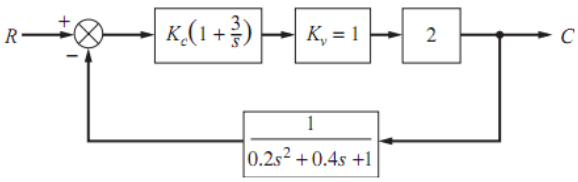
$$G(s)_{OL} = \frac{4K_c}{(s+1)(s+2)(s+3)}$$

Plot the root locus diagram on a separate graph sheet for

$$0 \le K_c \le 20$$

6 a) Discuss Bode diagram for following systems with rough sketch. [8M]
i) First order system ii) P-Controller iii) PD Controller iv) PI Controller

b) Consider the system shown below. [7M]



Construct the root locus diagram for the above system. If the system becomes unstable for high values of Kc, then determine the roots on the imaginary axis and corresponding value of Kc.

7 a) Explain in brief about the following : i) Cascade Control ii) Smith Predictor [6M]

b) Design Internal mode controller for a process which is first order with [9M]

$$G = K\frac{e^{-\tau_d s}}{\tau s + 1}$$

transport lag is approximated as first order pade as

$$e^{-\tau_d s} = \frac{1-(\tau_d / 2)s}{1+(\tau_d / 2)s}$$

8 a) Write in brief about tuning rules: [8M]
i) Ziegler-Nichols tuning rules ii) Cohen – Coon tuning rules

b) Brief about the following [7M]
i) Air to open valve ii) Air to close valve iii) Pneumatic actuator iv) Hydraulic Actuator

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