

**CH16504-Process Instrumentation Dynamics and Control**

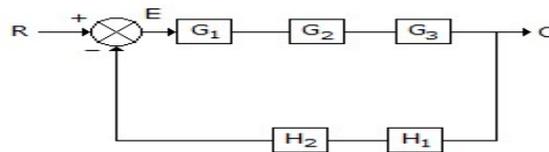
(Regulation 2016)

Time: Three hours

Maximum : 80 Marks

Answer **ALL** questions**PART A - (8 X 2 = 16 marks)**

- Which of the following thermocouples is incapable of measuring sub-zero (i.e.,  $< 0^{\circ}\text{C}$ ) temperature?
  - Chromel-alumel
  - Iron-constantan
  - Platinum-platinum + rhodium
  - Copper-constantan
- A control system has the following transfer function  $F(s) = [(s - 1)(s + 1)]/[s(s - 2)(s + 4)]$ . The initial value of the corresponding time function is
  - 1
  - 1/8
  - 7/8
  - 1
- What is the overall transfer function ( $C/R$ ) of the following block diagram if  $G = G_1 \cdot G_2 \cdot G_3$  and  $H = H_1 \cdot H_2$ .



- $1/(1 + GH)$
  - $G/(1 + GH)$
  - $H/(1 + GH)$
  - $G/(1 - GH)$
- A control system is unstable, if the open loop frequency response exhibits an amplitude ratio exceeding unity at the crossover frequency. This is \_\_\_\_\_ criterion.
    - Bode stability
    - Nyquist plot
    - Routh stability
    - None of these
  - Two first order systems connected in series is an over damped second order system- Justify.
  - For system with transfer function  $G(s) = e^{-2s}/(5s+1)$ , Calculate Amplitude Ratio and Phase lag.
  - With an example elucidate digital to analog converter.
  - Reset controller is used to reset the desired value – Justify.

**PART B - (4 X16 = 64 marks)**

- (a) Describe the principle and working of any one instrument used for the (16) measurement of following parameters.
  - Humidity of Gases
  - Vacuum pressure

**(OR)**

- (b) Explain pressure measurement in process industries using the following (16)  
transducers
- a) Capacitive transducer
  - b) Piezoelectric transducer
10. (a) (i) A liquid level system has a cross sectional area of 3 m<sup>2</sup> the valve (8)  
characteristics are  $7\sqrt{h}$  where q is the flow rate in m<sup>3</sup>/min and h is the  
level in meter. Compute the time constant for this system if the operating  
level is 4.1 m.
- (ii) If a forcing function f(t) has the following laplace transform, graph the (8)  
function f(t).  
 $f(s) = 1/s + (e^{-s} - e^{-2s})/s^2 + e^{-3s}/s$
- (OR)**
- (b) (i) For two interacting liquid level systems connected in series, obtain the (12)  
transfer function relating the liquid level in the second tank to the inflow  
to the first tank. Show that this second order system is over damped.
- (ii) Derive transfer function of transportation lag in a linear system. (4)
11. (a) (i) Using  $\tau_1 = 1, \tau_2 = \frac{1}{2}$  and  $\tau_3 = \frac{1}{3}$ , determine the values for K<sub>C</sub> for which the (12)  
control system is stable using Routh stability test.
- (ii) Describe the procedure for PID controller design using closed loop (04)  
method.
- (OR)**
- (b) Consider a feedback control system with open loop transfer function given (16)  
below  
 $G(s) = K_c e^{-5s}/[(s+1)(3s+1)]$ .  
Using Bode's stability criteria, calculate the value of K<sub>c</sub> at which the closed  
loop system becomes unstable.
12. (a) (i) Narrate the role of smith predictor in control system with an example. (8)
- (ii) With the neat sketch, explain various schemes involved to control bottom (8)  
product composition of distillation column.
- (OR)**
- (b) Elaborate the computer based control of CSTR with input and output DAQ (16)  
system with neat sketch.