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GIET MAIN CAMPUS AUTONOMOUS GUNUPUR – 765022

B. Tech Degree Examinations, December - 2020

(Fifth Semester)

BCHPC5010- PROCESS CONTROL AND INSTRUMENTATION

(Chemical Engineering)

Time: 2hrs

Maximum; 50 Marks

The figures in the right hand margin indicate marks.

PART – A: (Multiple Choice Questions)**(1 x 10= 10 Marks)****Q.1. Answer ALL questions**

- Manipulated variable In a water heater is which of the followings
 - The inlet water flow rate
 - The outlet water flow rate
 - The inlet water temperature
 - The heat input rate
- The transfer function of a process is $1/(16s^2 + 8s + 4)$. If a step change is introduced into the system, then the response will be
 - Under damped
 - Critically damped
 - Over damped
 - None of these
- The rate of response of the first order system is
 - Independent of time constant
 - Inversely proportional of time constant
 - Directly proportional of time constant
 - None of these
- Phase lag of the frequency response of a second order system to a sinusoidal forcing function
 - Approaches 180° asymptotically
 - Is 90° at the most
 - Is 30°
 - Is 120°
- In a –ve feed-back control system G and H denote forward path and backward path transfer functions respectively. The closed loop output-input relationship is
 - $G/(1 + H)$
 - $H(1 + G)$
 - $G/(1 + GH)$
 - G/H
- The inverse Laplace transform of the function $f(s) = 1/s(1 + s)$ is
 - $1 + e^t$
 - $1 - e^t$
 - $1 + e^{-t}$
 - $1 - e^{-t}$
- Routh stability method uses _____ loop transfer function.
 - Closed
 - Open
 - Either (i) or B(ii)
 - Neither (i) nor (ii)
- Use of I-control along with P-control facilitates
 - Reduction of offset
 - Reduction of oscillation
 - Elimination of offset
 - Reduction of stability time
- Cascade control is characterized by:
 - the presence of a “lead/lag” relay or function block
 - a special relay or function block to compensate for nonlinear process gain

- (iii) one controller providing a setpoint for another controller
- (iv) two controllers whose outputs are selected either by high or low value
- j. Zero-order hold used in practical reconstruction of continuous-time signals is mathematically represented as a weighted-sum of rectangular pulses shifted by:
- (i) Integer multiples of the sampling interval
- (ii) One sampling interval
- (iii) Any multiples of the sampling interval
- (iv) 1 second intervals

PART – B: (Short Answer Questions)

(2 x 5 = 10 Marks)

Q.2. Answer ALL questions

- What do you mean by characteristic equation of a control system?
- Write a brief note on cascade control system.
- What are Gain and Phase margins?
- What is Ziegler-Nichols controller tuning?
- What is corner frequency, cross over frequency and response frequency?

PART – C: (Long Answer Questions)

(6 x 5 = 30 Marks)

Answer ALL questions

Marks

- What is a feed forward control system? Explain in detail. (6)
- Find the Laplace inverse of $\frac{5s+3}{(s-1)(s^2+2s+5)}$ (6)
- A step change of magnitude 4 is introduced into a system having T.F.; (6)

$$\frac{Y(s)}{X(s)} = \frac{10}{S^2 + 1.6s + 4}$$

Determine: (a) % overshoot, (b) decay ratio, (c) ultimate value of Y(t), (d) max value of Y(t) (e) rise time.

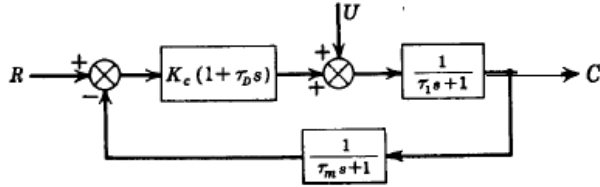
- Explain the working of a McLeod vacuum gauge with neat sketch. (6)
- For a control system the characteristic equation is (6)

$$s^4 + 4s^3 + 6s^2 + 4s + (1 + K) = 0$$

- Determine the value of K above which the system is unstable.
- Determine the value of K for which two of the roots are on the imaginary axis, and determine the values of these imaginary roots and the remaining two roots.

- A PD controller is used in a control system having a first-order process and a measurement lag as shown in Fig. (6)

- (i) Find expression for ζ and τ for the closed-loop response.
- (ii) If $\tau_1 = 1$ min, $\tau_m = 10$ sec, find K_c so that $\zeta = 0.7$ for the two cases:
 - (a) $\tau_D = 0$ Sec, (b) $\tau_D = 3$ sec.
- (iii) Compare the offset and comment on the advantage of adding the derivative mode.



9. The open-loop transfer function of a plant is given by: (6)

$$G(s) = \frac{e^{-2s}}{10s + 1}$$

Design a Dahlin digital controller for the system to achieve a closed-loop time constant of 5 s. Assume that $T = 1$ s.

10. Write the materials of construction and principles of working of Thermocouple with neat sketch. Show the emf temp curve. (6)

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