Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 90177

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2019
Third/Fourth/Fifth Semester
Electronics and Communication Engineering
EC8391 – CONTROL SYSTEMS ENGINEERING
(Common to Medical Electronics/ Electronics and Telecommunication Engineering/ Mechatronics Engineering)
(Regulations 2017)

Time : Three Hours | Maximum : 100 Marks

Answer ALL questions

PART – A **(10×2=20 Marks)**

1. Distinguish between feed forward control system and feedback control systems.

2. Specify the usefulness of AC servomotors in motion control systems.

3. Write the performance measures in transient response analysis of second order system.

4. For the given transfer function, find the type and order of the system $\frac{C(s)}{R(s)} = \frac{10(s+2)}{s(s^2+3s+5)}$.

5. In minimum phase system, how the starting and end point of polar plot are identified ?

6. Why compensators are necessary in feedback control systems ?

7. Comment on the stability of the system, when the roots of characteristic equation are lying on imaginary axis.

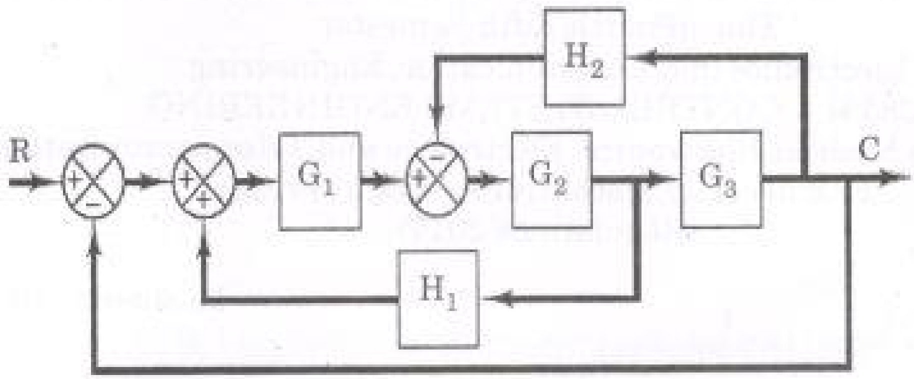
8. How do you define relative stability ?

9. Write the canonical form of state model for n^{th} order system.

10. Justify how digital Control System is superior to conventional control theory.

PART – B (5×13=65 Marks)

11. a) Draw the signal flow graph for the given system block diagram, and obtain the closed loop transfer function of the system C(S)/R(S) using Mason's Gain formula.



(OR)

b) Describe the construction and working principle of Synchros. Also explain how it is used in servo applications.

12. a) A unity feedback control system has an open loop transfer function $G(s) = \frac{10}{s(s+5)}$. Determine its closed loop transfer function, damping ratio and natural frequency of oscillations. Also evaluate the rise time, peak overshoot, peak time and settling time for a step input of 12 units.

(OR)

b) What is the need for PID control for feedback control systems ? Explain how it is designed for second order systems.

13. a) List out the frequency domain specifications of a standard second order system. Derive the expressions for Resonant peak and Bandwidth of a second order system.

(OR)

b) The open loop transfer function of a unity feedback system is $G(s) = K/(s(s+1))$. It is desired to have the velocity error constant $K_v = 12\ sec^{-1}$ and phase margin as 40°. Design a lead compensator to meet the above specifications.

14. a) Use the Routh stability criterion to determine the location of roots on the s-plane and hence the stability for the system represented by the characteristic equation $S^6 + S^5 + 3S^4 + 3S^3 + 5S^2 + 2S + 1 = 0$.

(OR)

b) Using Nyquist Stability Criterion, find the relative stability of the system whose open loop transfer function is defined as $G(s)\,H(s) = \dfrac{K(s+1)}{s^2(s+2)(s+4)}$.

15. a) The state model of the system is given by

$$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\\ \dot{x}_3\end{bmatrix} = \begin{bmatrix}0 & 0 & 1\\ -2 & -3 & 0\\ 0 & 2 & -3\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix} + \begin{bmatrix}0\\ 2\\ 0\end{bmatrix}u\,;\; y = \begin{bmatrix}1 & 0 & 0\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix}$$

Determine whether the system is completely controllable or not.

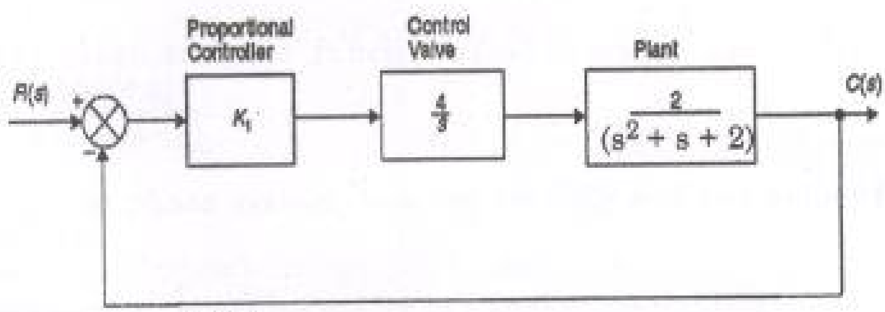
(OR)

b) Obtain the state model of the system whose transfer function s given as

$$\frac{Y(s)}{U(s)} = \frac{10}{s^3 + 4s^2 + 2s + 1}.$$

PART – C (1×15=15 Marks)

16. a) Sketch the root locus diagram of the control system as shown in figure; find the value of the proportional controller gain K_1 to make the system is just unstable.



(OR)

b) The open loop transfer function of the plant is

$$G(s)\,H(s) = \frac{10e^{-s\tau_D}}{s(0.1s+1)(0.05s+1)}$$

Use Bode plot, find the gain margin and phase margin when $\tau_D = 0$.