Reg. No. : [ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]

Question Paper Code : 11330

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2012.

Fourth Semester

Electronics and Communication Engineering

EC 2255/147405/EC 46/EE 1256 A/10144 EC 406/080290023 — CONTROL SYSTEMS

(Regulation 2008)

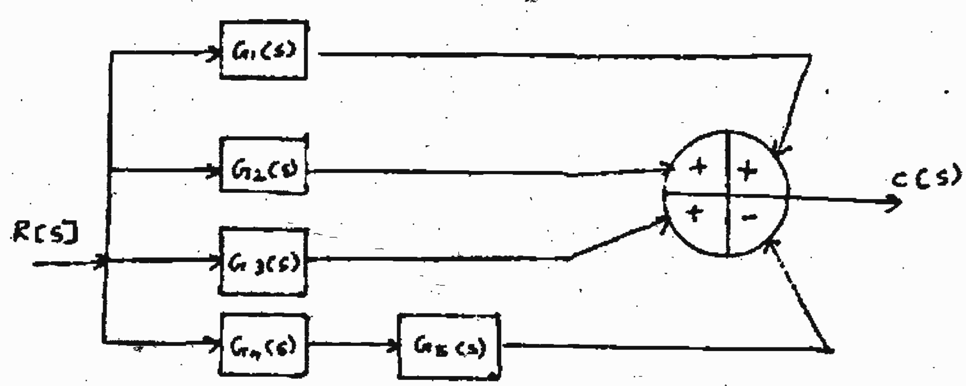
Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What are the advantages of the closed loop control system?

2. Write down the transfer function of the system whose block diagram is shown below.



3. What are transient and steady state responses of a control system?

4. With reference to time response of a control system, define 'peak time'.

5. What is meant by 'Corner frequency' in frequency response analysis?

6. What is Nichols chart?

7. State any two limitations of Routh-stability criterion.

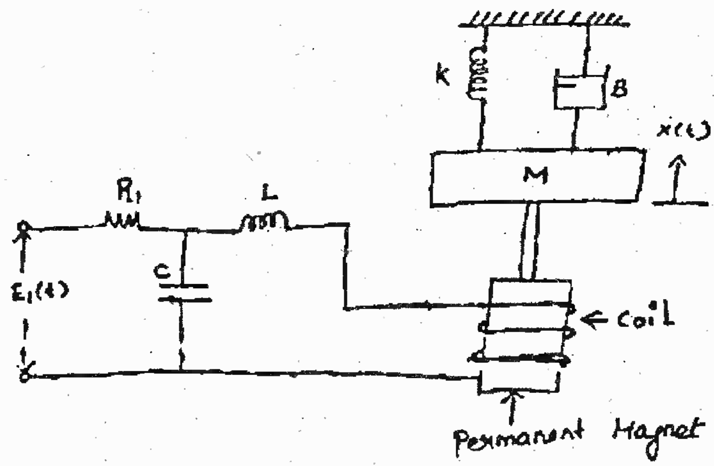
8. State the advantages of Nyquist stability criterion over that of Routh's criterion.

9. Define 'state' and 'state—variables'.

10. What is meant by Sampled—data control systems?

PART B — (5 × 16 = 80 marks)

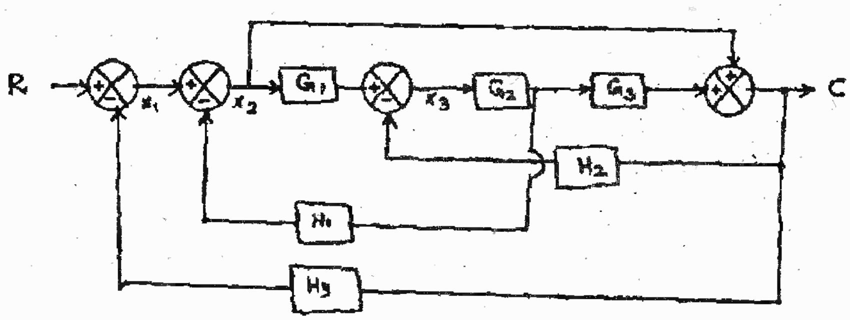
11. (a) In the system shown in figure below, R, L and C are electrical parameters while K, M and B are mechanical parameters.



Find the transfer function X(s)/E1 (s) for the system, where $E_1(t)$ is input voltage while x(t) is the output displacement. (16)

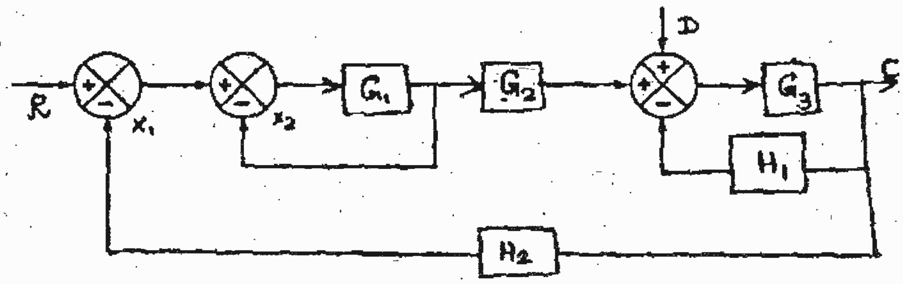
Or

(b) (i) A block diagram shown below.



Construct the equivalent Signal Flow Graph and obtain $\frac{C}{R}$ using Mason's formula. (8)

(ii) For the block diagram shown below, find the output C due to R and disturbance D. (8)



12. (a) (i) The unity feedback system is characterized by an open loop transfer function $G(s) = \frac{K}{s(s+10)}$. Determine the gain K, so that the system will have a damping ratio of 0.5. For this value of K, determine settling time, peak overshoot and time to peak overshoot for a unit step input. (8)

(ii) A unity feedback system has the forward transfer function $G(s) = \frac{K_1(2s+1)}{s(5s+1)(1+s)^2}$. The input $r(t) = (1+6t)$ is applied to the system. Determine the minimum value of K_1, if the steady error is to be less than 0.1. (8)

Or

(b) With suitable block diagrams and equations, explain the following types of controllers employed in control systems:

(i) Proportional controller (4)

(ii) Proportional-plus-integral controller (4)

(iii) PID controller (4)

(iv) Integral controller. (4)

13. (a) Given $G(s) = \frac{Ke^{-0.2s}}{s(s+2)(s+8)}$, find K for the following two cases:

(i) Gain margin equal to 6 db

(ii) Phase margin equal to 45°. (16)

Or

(b) Draw the pole-zero diagram of a lead compensator. Propose lead compensation using electrical network. Derive the transfer function. Draw the Bode plots. (16)

14. (a) (i) Determine the range of K for stability of unity feedback system whose open loop transfer function is $G(s) = \frac{K}{s(s+1)(s+2)}$ using Routh stability criterion. (6)

(ii) Draw the approximate root locus diagram for a closed loop system whose loop transfer function is given by $G(s)H(s) = \frac{K}{s(s+5)(s+10)}$ Comment on the stability. (10)

Or

(b) Sketch the Nyquist plot for a system with open loop transfer function $G(s)\,H(s) = \frac{K(1+0.4s)(s+1)}{(1+8s)(s-1)}$ and determine the range of K for which the system is stable. (16)

15. (a) The state space representation of a system is given below:

$$\begin{pmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{pmatrix} = \begin{pmatrix} -2 & 1 & 0 \\ 0 & -3 & 1 \\ -3 & -4 & -5 \end{pmatrix} \begin{pmatrix} x_1 \\ x_2 \\ x_3 \end{pmatrix} + \begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix} u \quad y = (0 \;\; 1 \;\; 0) \begin{pmatrix} x_1 \\ x_2 \\ x_3 \end{pmatrix}$$

obtain the transfer function. (16)

Or

(b) (i) Determine the controllability and observability of the following system:

$$\begin{pmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{pmatrix} = \begin{pmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & -2 & -3 \end{pmatrix} \begin{pmatrix} x_1 \\ x_2 \\ x_3 \end{pmatrix} + \begin{pmatrix} 0 \\ 0 \\ 10 \end{pmatrix} u \quad y = [1 \;\; 0 \;\; 0] \begin{pmatrix} x_1 \\ x_2 \\ x_3 \end{pmatrix}.$$

(8)

(ii) Obtain the z - domain transfer function of the system shown below. (8)