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

Question Paper Code: **11287**

B.E./B.Tech.Degree Examinations, April/May 2011
Regulations 2008

Fourth Semester

Electronics and Communication Engineering

EC 2255 Control Systems

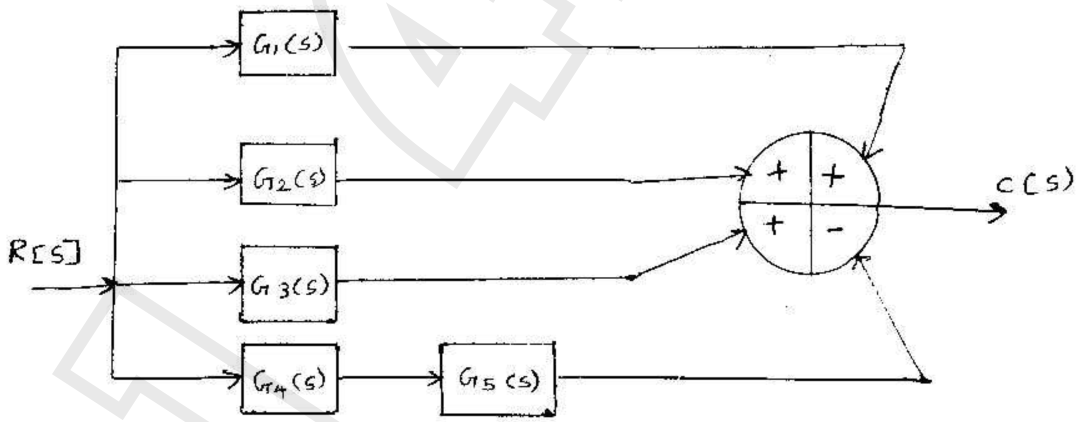
Time: Three Hours — Maximum: 100 marks

Answer ALL Questions

Part A - (10 x 2 = 20 marks)

1. Define open-loop *a*nd closed-loop control systems.

2. Write down *t*he transfer function *o*f the system whose block diagram i*s* shown below.



3. How a control system is classified depending on *t*he value o*f* damping?

4. Why derivative controller *i*s not used *i*n control system?

5. What *i*s meant by 'Corner frequency' in frequency response analysis?

6. Draw the circuit of lead compensator and draw its pole zero diagram.

7. State the rule for obtaining the breakaway point in root locus.

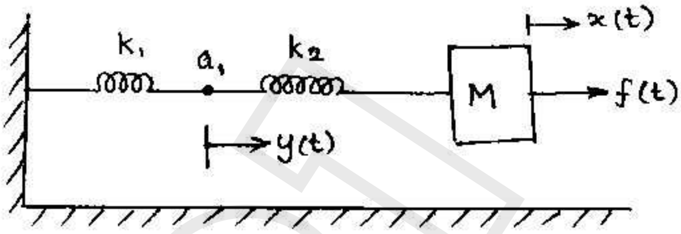
8. Define stability of a system.

9. Name the methods of state space representation for phase variables.

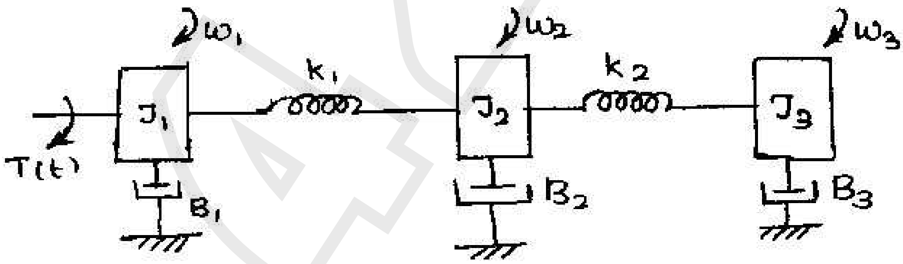
10. What is meant by quantization?

Part B - (5 x 16 = 80 marks)

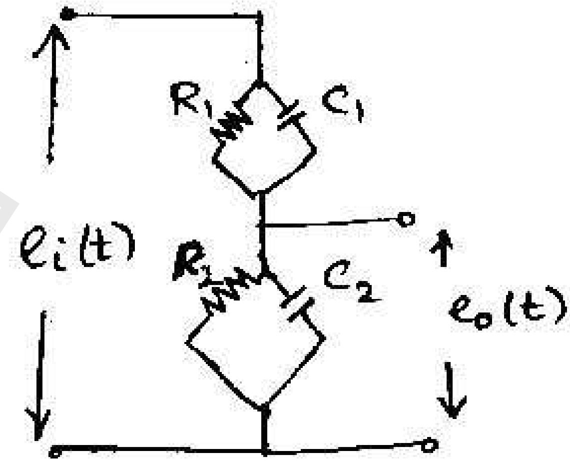
11. (a) (i) Consider the mechanical system shown below. Identify the variables and write the differential equation. (6)



(ii) Draw the torque-voltage electrical analogous circuit for the following mechanical system shown . (4)

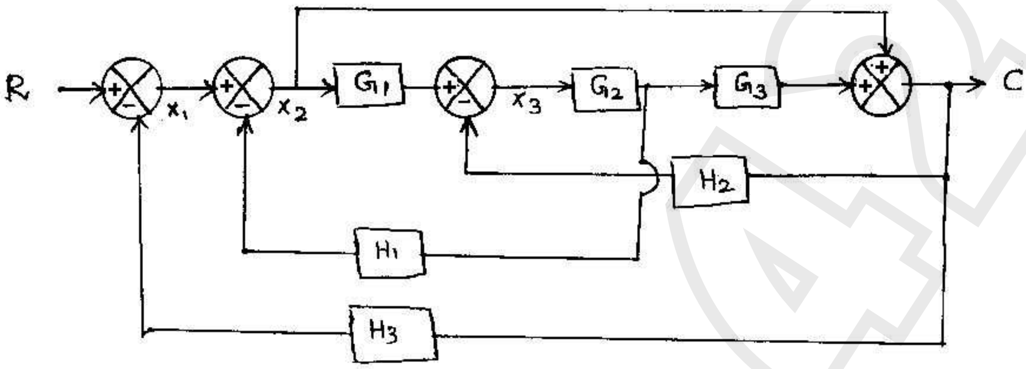


(iii) Obtain the transfer function of the following electrical network. (6)



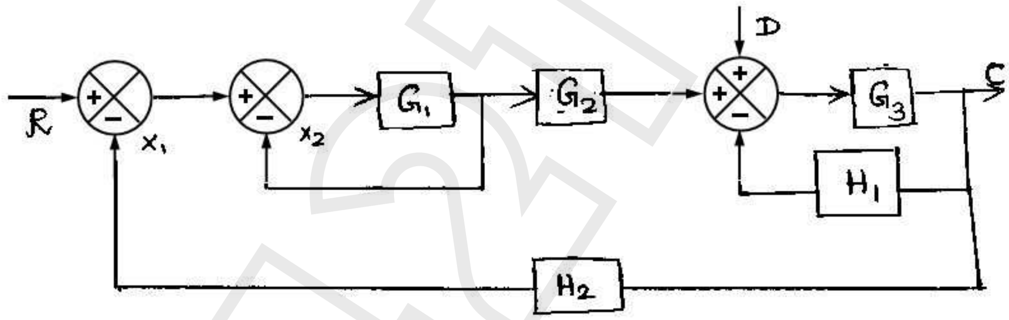
OR

11. (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

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

(1) Proportional controller (4)

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

(3) PID controller (4)

(4) Integral controller (4)

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

(i) gain margin equal to 6 db

(ii) Phase margin equal to 45°. (16)

OR

13. (b) The open loop transfer function of a unity feedback control system is

$$G_f(s) = \frac{k}{s(s+1)(s+2)}.$$

Design a suitable lag-lead compensator so as to meet the following specifications: Static velocity error constant $K_v = 10\ \text{sec}^{-1}$, phase margin = 50° and Gain margin ≥ 10 dB. (16)

14. (a) (i) A unity feedback system is characterized by the open-loop transfer function,

$$G(s) = \frac{k}{(s+2)(s^3+10s^2+49s+100)}.$$

Using Routh-Stability criterion, calculate the range of values of K for system to be stable. Determine the value of K, which will cause sustained oscillations in the closed loop system. Also determine the frequency of sustained oscillations. (10)

(ii) State the rules for construction of the Root-locus for a feedback system. (6)

OR

14. (b) Draw the Nyquist plot for the system whose open loop transfer function is

$$G(s)H(s) = \frac{K}{s(s+2)(s+10)}.$$

Determine the range of K for which the closed loop system is stable. (16)

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

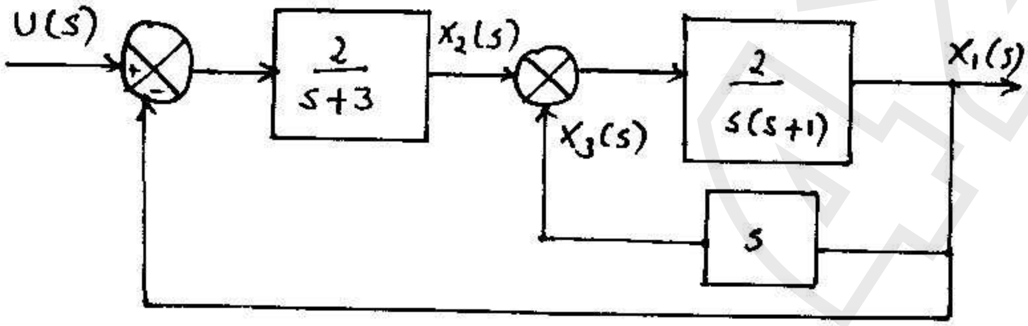
$$\begin{pmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{pmatrix} = \begin{pmatrix} -2 & 1 & 0 \\ 0 & -3 & 1 \\ -3 & -4 & -5 \end{pmatrix} \begin{pmatrix} x_1 \\ x_2 \\ x_3 \end{pmatrix} + \begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix} u$$

$$y = \begin{pmatrix} 0 & 1 & 0 \end{pmatrix} \begin{pmatrix} x_1 \\ x_2 \\ x_3 \end{pmatrix}$$

Obtain the transfer function. (16)

OR

15. (b) Write the state equations for the system shown below in which x_1, x_2 and x_3 constitute the state vector.



Determine whether the system is completely controllable and observable. (16)