**AU – 2671**

Fifth Semester B. E. (Electronics Engineering) Examination

## CONTROL SYSTEM ENGINEERING

Paper – 5 XN 03 / 5 XT 03

**( USC – 10670 )**

P. Pages : 5

Time : Three Hours ] [ Max. Marks : 80

**Note :** (1) Separate answer book must be used for each section in the subject Geology, Engineering material of Civil branch and separate answer book must be used for Section A and B in pharmacy and Cosmetic Tech.
(2) Answer **Three** questions from Section A and **Three** questions from Section B.
(3) Due credit will be given to neatness and adequate dimensions.
(4) Assume suitable data wherever necessary.
(5) Illustrate your answer wherever necessary with the help of neat sketches.
(6) Calculator is permitted.

### SECTION A

1. (a) Explain the following terms :—

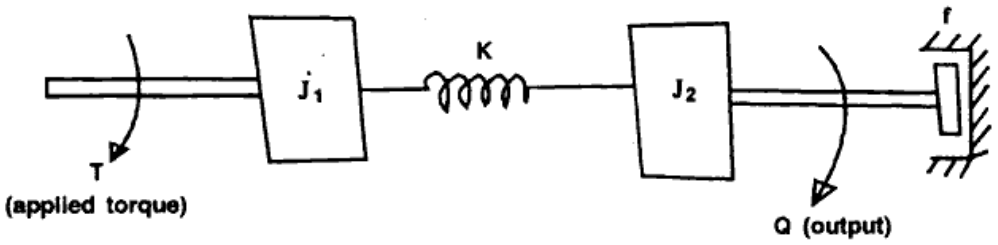
(i) Linear time – invariant systems

(ii) Linear time – varying systems

(iii) Open loop control systems

(iv) Closed loop control systems. 6

(b) Obtain the transister function of the mechanical system.

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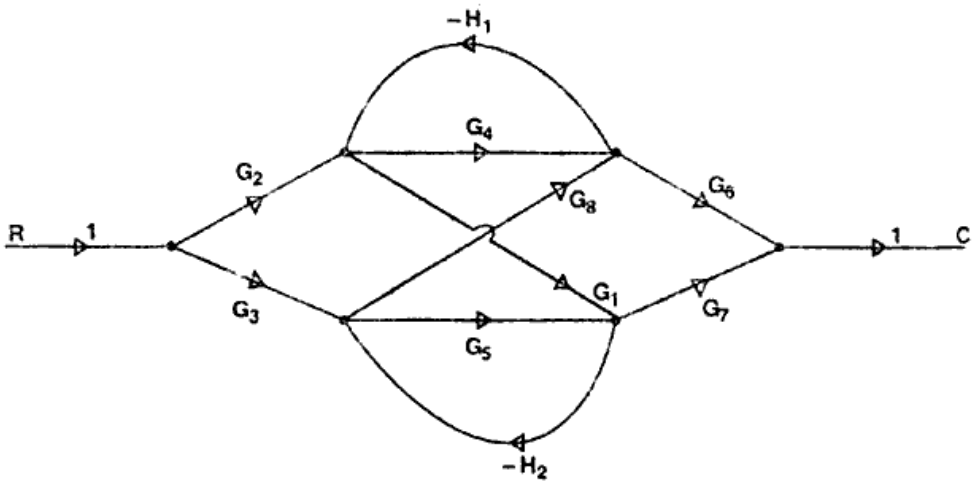
OR

2. (a) Define the term, 'transfer function' of the control system.
Derive the transfer function of generalized (single loop) feedback control system having G (S) as a forward path transfer function and H (S) as a feedback path transfer function.
Discuss the effect of feedback on overall gain, stability and sensitivity of the system. 6

(b) Determine the overall transfer function from the signal flow graph shown

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3. (a) For a unity feedback system having

$$G(S) = \frac{10(S+1)}{S^2(S+2)(S+10)}$$

Find type of the system, all error coefficient and steady state error for input given by the polynomial,

$$r(t) = 1 + 4t + \frac{4t^2}{2}$$

6

(b) A unity feedback system with an open loop transfer function

$$G(S) = \frac{K}{S(S+10)}$$

Determine the gain K so that the system will have damping ratio, $\xi = 0.5$. For this value of K, determine settling time, peak overshoot and time to peak overshoot for a unit step input. 8

OR

4. (a) Define time response specifications :—

(i) Delay time

(ii) Rise time

(iii) Settling time

(iv) Steady state error. 8

(b) For unity feedback system having

$$G(S) = \frac{K}{S^2 (S + 5)}$$

Find :—

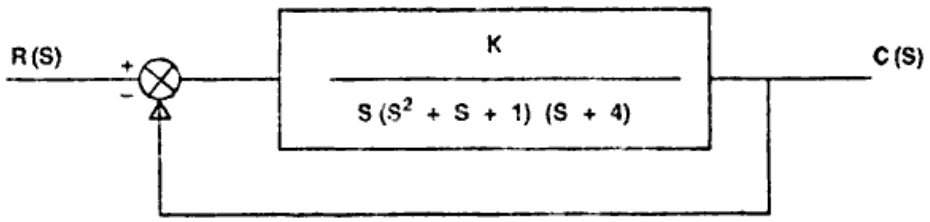
(i) $K_P$ , $K_V$ and $K_a$.

(ii) Steady state error for unit step position, unit ramp and unit acceleration input. 6



5. (a) What do you mean by stability of control systems ? What are the limitations of the Routh Hurwitz criterion to examine the stability from the characteristics polynomials. 6

(b) For a system as shown in




Determine the range of K for which system is stable. 7

OR

6. (a) A unity feedback system has an open loop transfer function

$$G(S) = \frac{K (S + 1)}{S (S - 1)}$$

Sketch the root locus with K as a variable parameter and show that the loci of complex roots are part of a circle with ( − 1 , 0) as centre and radius = $\sqrt{2}$. 13

## SECTION B

7. (a) Define the gain margin and phase margin. Show how these could be determined from :—

(i) Polar plot (ii) Bode plot 7

(b) Sketch the polar plot for the system having

$$G(S) \cdot H(S) = \frac{12}{S(S+1)(S+2)}$$

and determine :—

(i) Phase crossover frequency (ii) Gain Margin. 6

**OR**

8. (a) Explain in detail Nyquist stability criterion. 6

(b) Draw Bode plot for the unity feedback system with

$$G(S)H(S) = \frac{10}{S(1+0.5S)(1+0.1S)}$$ 7

9. (a) Explain the advantages of state variable approach over transfer function approach while analysis of control systems. 6

(b) A feedback system is characterised by the closed – loop transfer function

$$T(S) = \frac{S^2+3S+3}{S^3+2S^2+3S+1}$$

Draw a suitable signal flow graph and construct a state model of the system. 8

**OR**

10. (a) Obtain state model for the system represented by

$$\frac{d^3y}{dt^3} + 6\frac{d^2y}{dt^2} + 11\frac{dy}{dt} + 6y = u$$

in phase variable form, where y is output and u is input. 7

(b) Explain the concept of controllability of control systems. 7

11. (a) Explain working of sample data control systems. 6

(b) Find inverse Z transform for

$$X(z) = \frac{3z^2 + 2z + 1}{z^2 - 3z + 2}$$ 7

**OR**

12. (a) Solve the differential equation using Z – transform

$$X(K+2) + 3X(K+1) + 2X(K) = 0$$

with initial conditions, X (0) = 0 and X (1) = 1. 7

(b) Explain Jury's stability criterion. 6