B.E. (Electronics Engineering (Electronics & Power)) Sixth Semester (C.B.S.)

Control System-I

P. Pages : 4 **NRT/KS/19/3477**

Time : Three Hours * 0 5 9 9 * Max. Marks : 80

Notes :
1. All questions carry marks as indicated.
2. Solve Question 1 OR Questions No. 2.
3. Solve Question 3 OR Questions No. 4.
4. Solve Question 5 OR Questions No. 6.
5. Solve Question 7 OR Questions No. 8.
6. Solve Question 9 OR Questions No. 10.
7. Solve Question 11 OR Questions No. 12.
8. Assume suitable data whenever necessary.
9. Illustrate your answers whenever necessary with the help of neat sketches.
10. Use of non programmable calculator is permitted.

1. a) Obtain the X for function $\frac{X(s)}{U(s)}$ for the system which is defined by **7**

$$x = x_1 + \beta_3 U$$

$$\dot{x}_1 = \alpha_1 x_1 + x_2 = \beta_2 U$$

$$\dot{x}_2 = -\alpha_2 x_1 + \beta_1 U$$

b) Obtain the transfer function of the mechanical system as shown in 'fig 1 (b)' below. Find transfer function $= \frac{\theta_0(s)}{T(s)}$ **6**

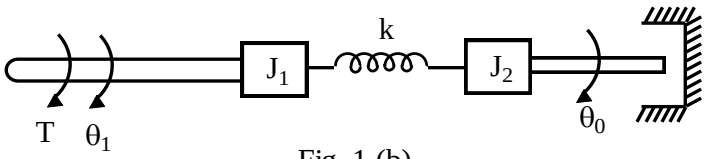

Fig. 1 (b)

OR

2. a) Using Block Diagram Reduction Technique find the equivalent open loop transfer function, for the system, shown in 'fig 2 (a)' **7**

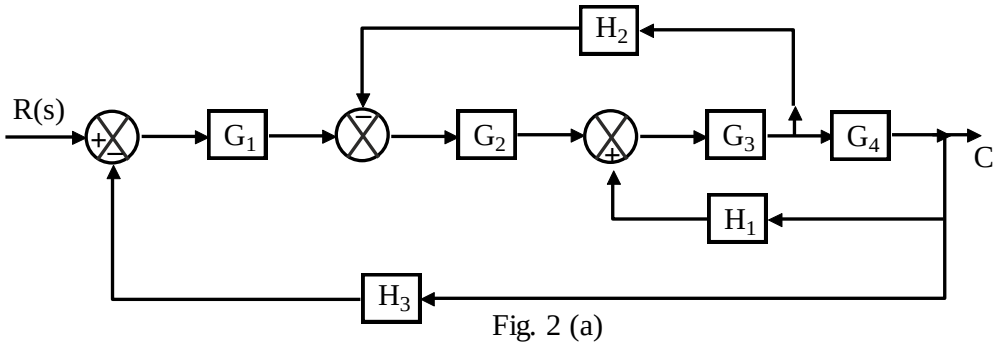

Fig. 2 (a)

b) Prove that the Use of feedback improves the transient response or improves the speed of response. **6**

3. a) Derive the transfer function of Armature controlled D. C. servomotor. **6**

b) Explain Potentiometer as an Error detector. **7**

OR

4. a) Write a short note on synchro transmitter and receiver pair with neat sketch. **6**

b) For the system shown in 'Fig 4(b)', evaluate sensitivities at w = 1 rad/sec. **7**

i) S_a^T ii) S_b^T iii) S_k^T

Assume k = 10, a = 2, b = 1

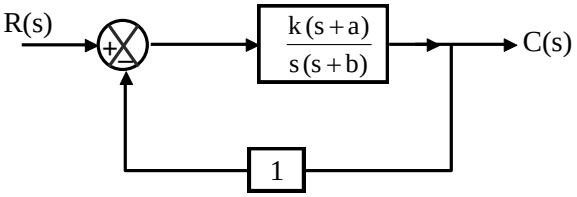

Fig. 4(b)

5. a) What do you mean by 'Time - Response' of any control system? Mention and define various times response specifications. **6**

b) For a unity feedback system with forward path transfer function given as **7**

$G(s) = \dfrac{10[s+1]}{s^2(s+2)(s+10)}$. Determine.

i) Type of system.

ii) Steady state Error for an input of $r(t) = 1 + 4t + \dfrac{t^2}{2}$.

OR

6. a) Discuss the effect of performance of a second order control system of :- **5**

i) Derivative control ii) Integral control

b) **8**

A unity feedback control system has $G(s) = \dfrac{100}{s(s+5)}$. If it is subjected to unit step i/p, determine,

(1) Damped frequency of oscillations
(2) Max^m overshoot
(3) Time for first overshoot
(4) Settling time.
(5) Output response

7. a) Consider the 4th order system whose characteristics equation is **7**

$s^4 + 8s^3 + 18s^2 + 16s + 5 = 0.$

Comment on stability of system by Hurwitz stability criterion.

b) A feedback control system has $G(s)\,H(s) = \dfrac{ke^{-ST_d}}{s\left(s^2+5s+9\right)}$. For the closed loop system obtain stability boundary in parameter plane [K-T_d]. Also obtain the maximum permissible gain for stability when T_d = 1 sec. **7**

OR

8. The open Loop transfer function of a unity feedback system is given by **8**

$$G(s) = \frac{K}{s(s+2)(s+4)}.$$

a) Sketch the root Locus of system. **3**

b) Determine gain K for critical damping. **3**

c) Find the range of values of K for which system has damped oscillatory response.

9. Sketch the Bode plot for the transfer function **14**

$$G(s) = \frac{1000}{s(1+0.1s)(1+0.001s)}.$$

from the graph determine.

i) Gain cross over frequency.
ii) Phase cross over frequency.
iii) Gain margin and phase margin.
iv) Stability of the given system.

OR

10. a) Sketch the polar plot for the system with open loop transfer function **7**

$$G(s)\,H(s) = \frac{1}{(s+2)(s+4)}$$

b) The specifications on a second order unity feedback control system with the closed loop transfer function. **7**

$\dfrac{C(s)}{R(s)} = \dfrac{\omega_n^2}{s^2+2\xi\omega_n s+\omega_n^2}$ are that the over shoot of the step response should not exceed 12% and the peak time must be less than 0.25. Find the corresponding frequency, Response value of peak resonance, resonant frequency and Bandwidth.

11. a) Determine the system transfer function using the following state equation:- **6**

$$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix} = \begin{bmatrix}-5 & -1\\ 3 & -1\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix} + \begin{bmatrix}2\\ 5\end{bmatrix} U$$

$$y = \begin{bmatrix}1 & 2\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}$$

b) The closed loop transfer function of the system is given below **7**

$$\frac{C(s)}{R(s)} = \frac{24}{(s+1)(s+2)(s+3)}$$

Determine two different state models for the system.

OR

12. a) **8**

Closed loop transfer function of a system is given by $T_{(s)} = \frac{s^2+3s+3}{s^3+2s^2+3s+1}$. Draw the signal flow graph for the system and hence obtain the state model for the system.

b) Obtain the state mode for the following Electrical network shown in fig 12 (b). **5**

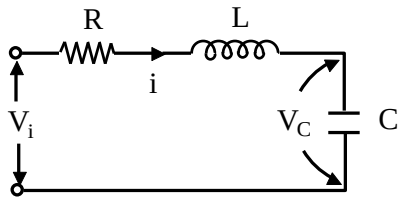

Fig. 12 (b)

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