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

Control System - I

P. Pages : 4 **NRJ/KW/17/4532**

Time : Three Hours * 0 1 2 4 * 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) Define linear control system. Differentiate between open loop & feedback control system with its advantages and disadvantages. **5**

b) Using MASON's GAIN FORMLAE, determine the ratio '$\frac{C}{R}$' of 'fig. 1 (b)'. **8**

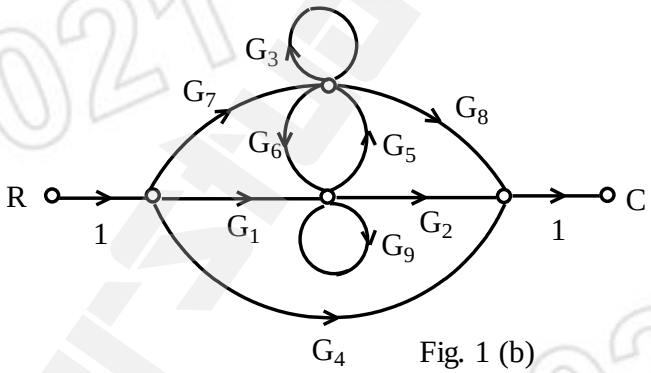

Fig. 1 (b)

OR

2. a) Draw the 'SIGNAL FLOW GRAPH' of the electrical network shown in 'fig. 2(a)'. Hence find the value of '$V_o(s)$'. **6**

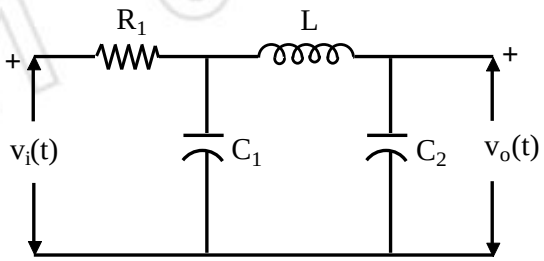

Fig. 2 (a)

b) Find the 'TRANSFER FUNCTION' for the block diagram shown in 'fig. 2 (b)' using block diagram reduction technique rules. **7**

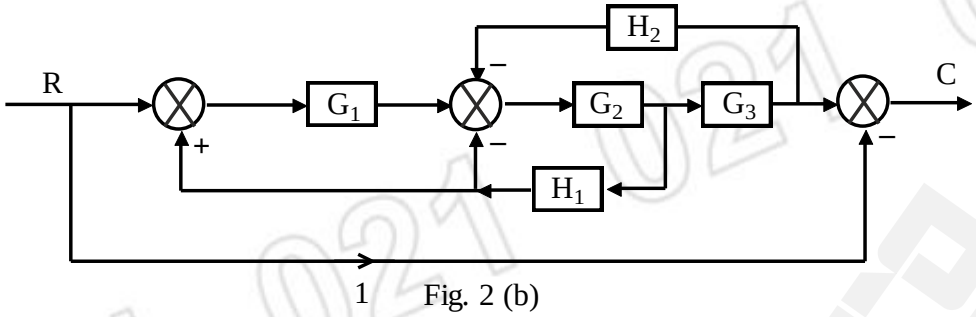

Fig. 2 (b)

3. a) Define Sensitivity. Explain the effect of feedback on control system sensitivity in detail. **6**

b) The block diagram of position control system is shown in 'fig. 3 (b)'. Determine sensitivity of closed loop transfer function - T w.r.t. G and H. Given : $w = 50\,rad/sec$. **7**

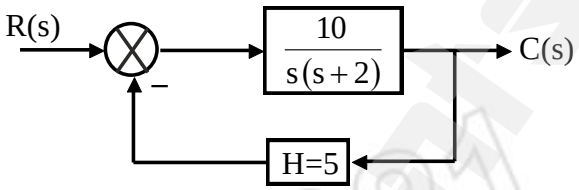

Fig. 3 (b)

OR

4. a) Derive the transfer function of a 'FIELD CONTROLLED D. C. SERVOMOTOR'. **6**

b) Write a short note on : **7**
SYNCHRO TRANSMITTER
RECEIVER PAIR

5. a) The block diagram of electronic pacemaker is shown in 'fig. 5 (a)'. Determine 'STEADY STATE ERROR' for unit RAMP input when 'K = 400'. Also determine value of 'K' for which the steady state error for unit RAMP input will be 0.05. **6**

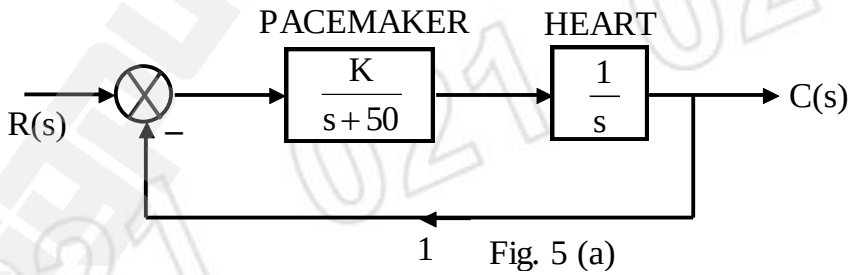

Fig. 5 (a)

b) Discuss the effect of performance of a second order system of - **5**
i) Derivative control
ii) Integral control

c) Determine the expression for 'RISE TIME' for second order underdamped feedback control system. **3**

OR

6. a) The open loop transfer function of a unity feedback system is given by - **7**

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

By what factor should the gain - k is multiplied to increase the damping ratio from 0.15 to 0.6.

b) For a feedback control system having **7**

$$G(s) = \frac{K}{s(s+0.15)} \text{ and } H(s) = 0.1$$

i) Determine the value of 'K' for the system having damping ratio of 0.5.
ii) For this value of 'K', determine output response of a system for a STEP INPUT OF 10 - units.

7. a) Sketch the complete 'ROOT LOCUS' for the system having - **9**

$$G(s)H(s) = \frac{K(s+5)}{s^2+4s+20}$$

b) Write a short note on : EFFECT OF ADDITION OF POLES AND ZEROS ON ROOT LOCUS. **5**

OR

8. a) Define 'RELATIVE STABILITY'. Explain how 'ROUTH's CRITERION' can be used to determine Relative stability. **4**

b) A unity feedback system with **6**

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

Find the value of 'K' that makes the system to oscillate and frequency of oscillations.

c) Explain 'ROUTH - HURWITZ CRITERION' with different difficulties. **4**

9. Sketch BODE PLOT for the following : **13**

$$G(s)H(s) = \frac{100}{s(s+1)(s+2)}$$

Determine the gain cross over frequency phase cross over frequency phase margin and gain margin. Comment on the stability of the system.

OR

10. a) The forward path transfer function of a unity feedback system. **7**

$$G(s) = \frac{100}{s(s+6.54)}$$

Find resonant frequency, resonant peak and bandwidth of closed loop system.

b) Sketch a 'POLAR PLOT' if **6**

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

11. a) The transfer function of a linear time invariant system is given by - **9**

$$\frac{Y(s)}{R(s)} = \frac{3s^2 + 2s + 6}{s^3 + 7s^2 + 14s + 8}$$

Derive a state model of a system in 'DIAGONAL FORM' and draw the block diagram representation.

b) Define : **4**

i) State

ii) State trajectory

iii) State variable

iv) State space

OR

12. a) The state space of a system is represented by the following equation : **7**

$$\dot{\underline{x}} = \begin{bmatrix} -3 & 1 \\ -2 & 0 \end{bmatrix} \underline{x} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} \underline{u}$$

$$\underline{y} = \begin{bmatrix} 1 & 0 \end{bmatrix} \underline{x}$$

i) Find the TRANSFER FUNCTION' of the system.

ii) Check the 'STABILITY' of the system.

b) Obtain the 'STATE MODEL' for the given transfer function using 'PHASE VARIABLE METHOD'. **6**

$$\frac{Y(s)}{U(s)} = \frac{K(C_2 s + C_1)}{S^3 + a_3 s^2 + a_2 s + a_1}$$

Also draw the block diagram of the state model.

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