NEW SCHEME

EE43

USN | | | | | | | | | | |

Fourth Semester B.E. Degree Examination, January/February 2005

EE / EC / IT / TC / BM/ ML

Control Systems

Time: 3 hrs.] [Max.Marks : 100

Note: *Answer any FIVE full questions.*
2. All questions carry equal marks.

1. (a) Distinguish between open loop and closed loop control systems. Give examples for each. **(8 Marks)**

(b) The circuit shown in figure (1) (b) is called a lead-lag filter. Find the transfer function $\frac{V_2(s)}{V_1(s)}$ when $R_1 = 100\Omega$, $R_2 = 200k\Omega$, $C_1 = 1\mu F$ *and* $C_2 = 0.1\mu F$ **(6 Marks)**

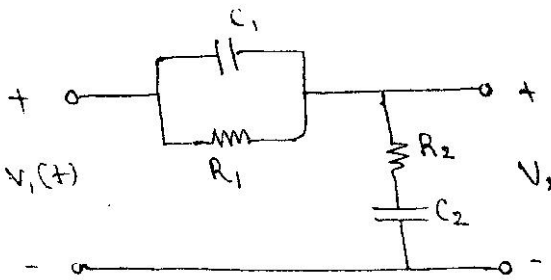

Fig. 1(b)

(c) For the mechanical system shown in figure (1) (c) write the differential equations of performance and draw the mechanical network. **(6 Marks)**

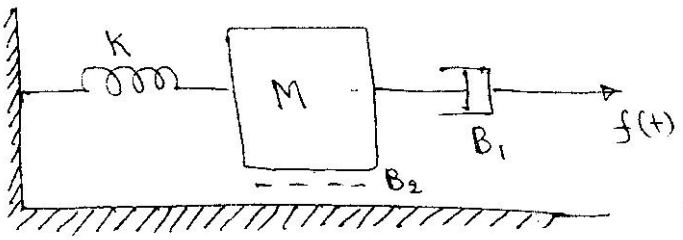

fig. 1(c)

2. (a) The block diagram of a feedback control system is shown in figure (2) (a). Find

i) the transfer function $Y(s) \mid E(s)$ *with* $N = 0$

ii) the transfer function $Y(s) \mid N(s)$ *with* $R = 0$ **(8 Marks)**

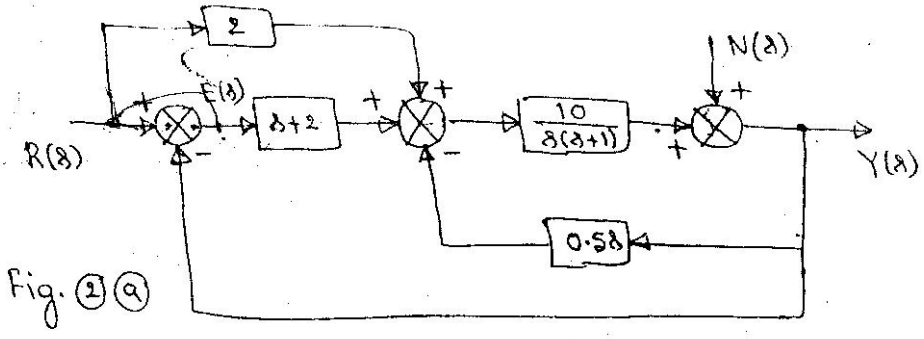

Fig. 2(a)

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(b) What are the disadvantages of block diagram representation? (3 Marks)

(c) For the signal flow graph shown in fig (2) (c), find the transfer function $\frac{C(s)}{R(s)}$ using Mason's gain formula. (9 Marks)

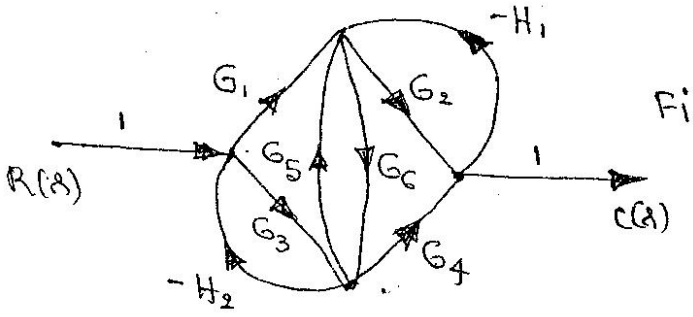

Fig. (2) (c)

3. (a) Refer the figure (3) (a), find the following

i) transfer function $\frac{X(s)}{F(s)}$ and

ii) $\xi, w_n, \%M_p, t_s \; and \; t_p$

Take : $K = 33N/m$

$B = 15N - s/m$

$M = 3Kg$

(10 Marks)

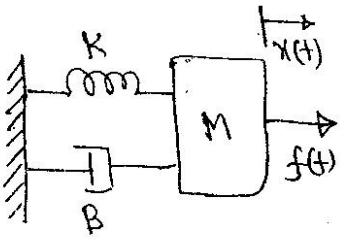

Fig (3) (a)

(b) Find the error constants K_p, K_v and K_a for the unity feed back system represented by the following open loop transfer function.

$G(s) = \frac{100}{s^2(s+2)(s+5)}$

Determine the steady state error when the input is $r(t) = 1 + t + 2t^2$. What is the type and order of this system? (10 Marks)

4. (a) State and explain Routh - Hurwitz criterion of stability. What are its limitations? (6 Marks)

(b) Determine the number of roots that are (i) in the left half of s-plane, (ii) on the imaginary axis and (iii) in the right half of s-plane for the system with the characteristic equation $s^5 - s^4 - 2s^3 + 2s^2 - 8s + 8 = 0$ (8 Marks)

(c) An open loop transfer function has poles at $s = 0, s = -1$ and a zero at $s = -2$. Check the range of K for the stability of the closed loop system. (6 Marks)

Contd.... 3

5. (a) Sketch the complete root locus of the system having

$$G(s)H(s) = \frac{K}{s(s+1)(s+2)(s+3)}$$ **(16 Marks)**

(b) Explain the terms absolute stability and conditional stability. **(4 Marks)**

6. (a) State the advantages of Bode plots. **(2 Marks)**

(b) Distinguish between gain margin and phase margin. **(4 Marks)**

(c) Plot the Bode magnitude and phase diagrams for the open loop transfer function

$$G(s)H(s) = \frac{100(s+2)}{s(s+4)(s+5)}$$

Discuss the stability of the closed loop system. **(14 Marks)**

7. (a) State and explain Nyquist stability criterion. **(6 Marks)**

(b) Use Nyquist stability analysis to determine the stability range of K if

$$G(s)H(s) = \frac{K(s+5}{s(s-2)}$$ **(14 Marks)**

8. (a) Obtain the open loop transfer function of the control system whose Bode magnitude plot is shown in figure 8(a). **(10 Marks)**

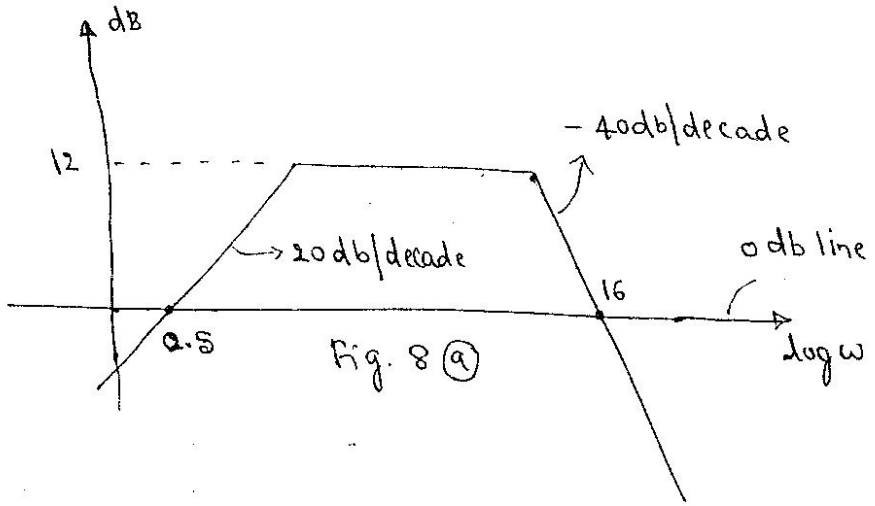

Fig. 8 (a)

(b) Comment on the following statements: **(2×5=10 Marks)**

i) An increase in damping ratio increases the rise time.

ii) Unit impulse response of a system in s-domain gives the transfer function.