EE43

USN

**NEW SCHEME**

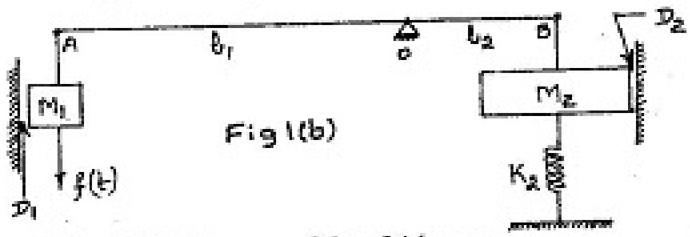
# Fourth Semester B.E. Degree Examination, Dec. 06 / Jan. 07
## Electrical and Electronics Engineering
## Control Systems

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

**Note : *Answer any FIVE full questions.***

1 a. Explain the difference between open loop and closed loop control systems, with suitable examples. **(08 Marks)**

b. For the mechanical system shown in the fig1(b), draw the force-voltage analogous electrical system and determine the displacements as function of time at A & B; also draw approximately these displacements. The applied force is a unit impulse. **(12 Marks)**




$F(t) = \delta(t)$ N. $M_2 = 24$ kgms $l_1 = 100$ cms

$M_1 = 4$ kgms $D_2 = 60$ N / m / sec $l_2 = 25$ cms

$D_1 = 5$ N / m / sec $K_2 = 1.25$ cms / N (spring compliance)

2 a. For a negative feedback control system, starting from fundamentals, show that the closed loop transfer function M(s) is given by **(08 Marks)**

$$M(s) = \frac{N_g D_h}{(D_g D_h + N_g N_h)}, \text{ where } G(s) = \frac{N_g}{D_g} \; ; \; H(s) = \frac{N_h}{D_h}$$

b. The performance equations of a controlled system are given by the following set of linear algebraic equations. Draw the block diagram and determine $\frac{C(s)}{R(s)}$ by reducing the block diagram in steps.

$E_1(s) = R(s) - H_3(s)\, C(s)$

$E_2(s) = E_1(s) - H_1(s)\, E_4(s)$

$E_3(s) = G_1(s)\, E_2(s) - H_2(s)\, C(s)$

$E_4(s) = G_2(s)\; E_3(s)$

$C(s) = G_3(s)\; E_4(s)$ **(12 Marks)**

3 a. For the circuit shown in the Fig.3(a), write the performance equations considering the voltage and current variables as indicated, draw the corresponding signal flow graph and determine $I_3(s)/V_1(s)$ using Mason's Gain formula. **(14 Marks)**

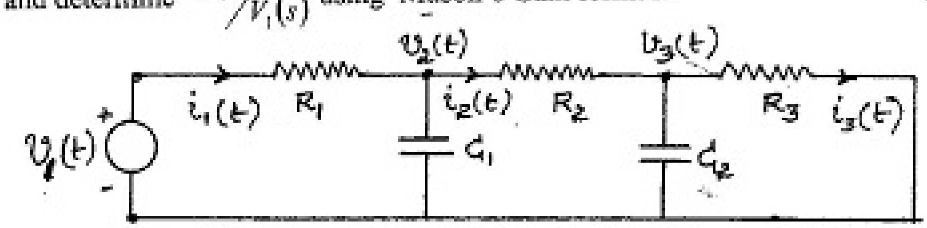



Fig.3(a)

$R_1 = 100k\Omega$ ; $R_2 = 50k\Omega$ ; $R_3 = 40k\Omega$ ; $C_1 = 10\mu F$ ; $C_2 = 5\mu F$

b. Briefly explain the following with examples :
   i) Part of signal flow graph not touching a forward path.
   ii) Mixed Node. **(06 Marks)**

4 a. What are impulse and step signals? How are they defined mathematically? What are their Lap lace Transformations? **(06 Marks)**

b. Starting from fundamentals, derive an expression for the step response of a typical under damped second order closed loop control system. Show the typical variation of the response and mark the settling time on a 5% tolerance basis. **(14 Marks)**

5 a. What are static error co-efficients? Derive expressions for the same. **(08 Marks)**

b. A negative feedback control system has

$$G(s) = \frac{K}{s(s^2+s+1)} \quad \text{and} \quad H(s) = \frac{1}{s+4}$$

Determine the range of k for the absolute stability of the system ; also determine the frequency of sustained self oscillations for the limiting value of k. **(12 Marks)**

6 a. State the rules for the construction of Root Loci of the characteristic equation of a feedback control system. **(06 Marks)**

b. For a negative feedback control system,

$$G(s) = {k}\Big/{s(s^2+4s+13)} \quad \text{and} \quad H(s) = \frac{1}{(s+4)}$$

Obtain the root locus for the root of the characteristic equation and plot the same using a scale of 1 unit of Real s = 2 cm and 1 unit of Imaginary s = 2 cm. **(14 Marks)**

7 a. For a closed loop control system, $G(s) = \frac{100}{s(s+8)}$ , H (s) = 1. Determine the Resonant Peak and Resonant Frequency. **(06 Marks)**

b. A negative feedback control system has $G(s) = \frac{K}{(s+1)(s+4)}$ and $H(s) = \frac{1}{s}$

Obtain the complete Nyquist plot (G H Locus ) and discuss the stability of the system (with respect to the variable parameter k). **(14 Marks)**

8 a. Show that for a unity feedback control system with $G(s) = {K}\Big/{s(s+a)(s+b)}$,

$G(jw_c) = \frac{-K}{ab(a+b)}$ , where 'W$_c$' is the phase cross over frequency. **(06 Marks)**

b. Given $G(s) = {80000}\Big/{s(s+2)(s+50)(s+200)}$ for a unity feedback control system, draw the Bode Plots and hence determine the Phase Margin and Gain Margin. **(14 Marks)**