IC-501 **Roll No.** | | | | | | | | | | |

B. Tech.
(SEM V) ODD SEMESTER EXAMINATION 2015-16
CONTROL SYSTEM-I

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

Note- Attempt all questions. ***All Questions carry equal marks.***

1. Attempt any **FOUR** of the following questions: **[4 x 5=20]**

(a) What is feedback? Discuss its effect on overall gain and sensitivity.

(b) What are the basic components of the control system?

(c) Determine the Transfer function $e_o(s)/e_i(s)$ of Fig.1 below:

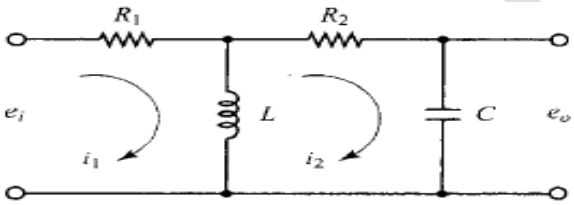


Fig.1

(d) How F-V analogy differ from F-I analogy? Obtain the System equations for the System shown in Fig.2 with the help of F-V analogy.

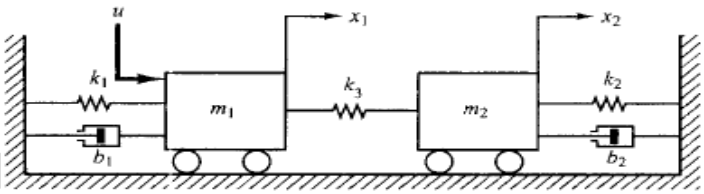


Fig.2

(e) For the system represented by the given equations find the transfer function x_5 / x_1 by the help of signal flow graph technique.(where x_1 is the input variable and x_5 is the output variable)

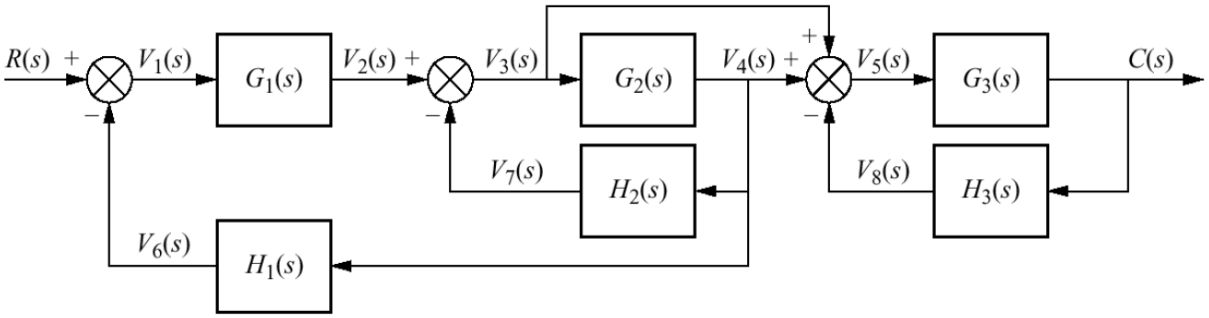
$$x_2 = a_{12}x_1 + a_{32}x_3 + a_{42}x_4 + a_{52}x_5$$

$$x_3 = a_{23}x_2$$

$$x_4 = a_{34}x_3 + a_{44}x_4$$

$$x_5 = a_{35}x_3 + a_{45}x_4$$

(f) Find the overall transfer function using block diagram reduction technique.



2. Attempt any **TWO** of the following questions: **[2 x10=20]**

(a) What is state transition matrix? State all its properties and prove it.

(b) Obtain the state transition matrix of $G(s)= 25(15s+3)/(s^3+5s^2+7s+1)$.Also draw the state diagram.

(c) Obtain the state transition matrix

i. when $dx/dt=\begin{bmatrix}-1 & 0\\ 1 & -2\end{bmatrix}x$

ii. Find the STM and also determine x(t) when $dx/dt=\begin{bmatrix}0 & 1\\ -6 & -5\end{bmatrix}x$; $x(0)=\begin{matrix}0\\1\end{matrix}$

3. Attempt any **FOUR** of the following questions: **[4 x 5 =20]**

(a) Derive the steady state error relation of unit step response of first order system.

(b) Define the transient response specifications of second order system.

(c) The OLTF with unity feedback is given by $G(s) =10 / (s+5)(s+2)$. Determine the damping ratio, undamped natural frequency. What is the % overshoot to a unit step response?

(d) Consider the unit step response of a unity feedback system whose OLTF is $G(s) =1 / s (s+2)$. Obtain the rise time, peak time, maximum overshoot and settling time.

(e) Determine the static error coefficients and steady state error for input $r(t)= 2+5t+4t^2$ when open loop transfer function is $G(s)H(s) = 108 / s^2(s+4)(s^2+3s+12)$.

(f) The OLTF with unity feedback is $G(s) =10 / s (0.1s+1)$. Evaluate the static error constants(K_p, K_v and K_a).

4. Attempt any **TWO** of the following questions: **[2 x10=20]**

(a) Plot the root locii of the system $G(s) = K / s (s^2+4s+8)$. Also determine the angle of departure and breakaway point.

(b) Sketch the root locus for the unity feedback whose open loop transfer function $G(s) = K (s+1) / s^2 (s+3.6)$.

(c) State Routh Hurwitz criteria. The characteristic equation is given as $s^4+20s^3+15s^2+2s+K=0$.

i. Determine the range of K for the system to be stable.

ii. Find the required value of K when the system is marginally stable.

5. Attempt any **TWO** of the following questions: **[2 x10=20]**

(a) Define gain margin and phase margin as well as gain crossover frequency and phase crossover frequency.

(b) Plot the bode plot and obtain the phase and gain cross over frequencies when $G(s) = 10/s(1+0.4s)(1+0.1s)$.

(c) Draw the nyquist plot for the system whose TF is $G(s)H(s) = K/s(s+2)(s+10)$. Determine the range of K of which the system is stable.