Code No: RT31043 **R13** SET - 1

III B. Tech I Semester Regular/Supplementary Examinations, October/November - 2017

CONTROL SYSTEMS

(Common to Electronics and Communication Engineering and Electronics and Instrumentation Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B**)
2. Answering the question in **Part-A** is compulsory
3. Answer any **THREE** Questions from **Part-B**
(Normal and semi & polar graph sheet are the supplied)

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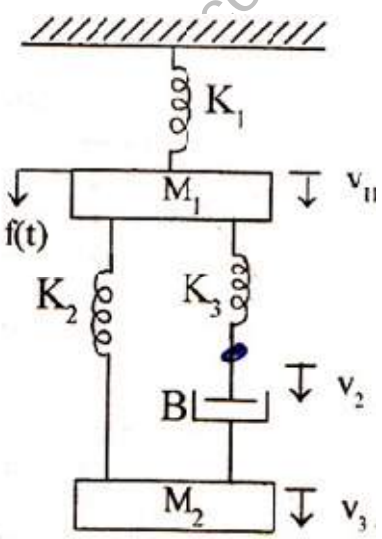
PART –A

1	a)	What is meant by open loop control system?	[3M]
	b)	Compare the AC and DC servomotor.	[4M]
	c)	Explain about steady state error	[3M]
	d)	What are limitations of Routh's stability criterion?	[4M]
	e)	Define phase and gain crossover frequency	[4M]
	f)	Explain about obsevability	[4M]

PART -B

2	a)	Derive the transfer function of translational mechanical systems.	[8M]
	b)	Determine the transfer function $\frac{V_3(s)}{F(s)}$, for the system show in below figure:	[8M]



3	a)	Derive the transfer function and develop the block diagram of armature controlled DC servo motor.	[8M]
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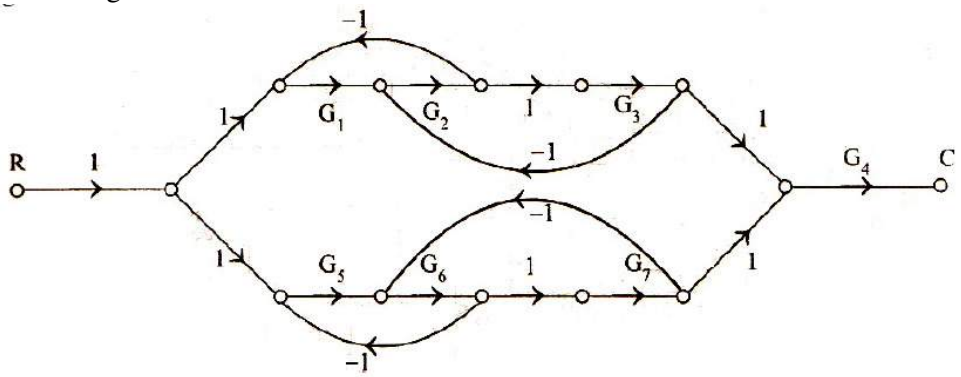
b) Find the transfer function for control function shown below figure using Mason's gain formula [8M]



4 a) Derive the expressions for peak time and settling time of a standard second order under damped system. [8M]

b) Determine the step, ramp and parabolic error constants of the following unity feedback control system whose open loop transfer function is given by [8M]

$$G(s) = \frac{1000}{(1+2S)(1+0.5S)}$$

5 a) The characteristics equation for a certain feedback control system is given by $S^4 + 22S^3 + 10S^2 + 2S + K = 0$,Find K which corresponds to the stable system [8M]

b) Plot the root locus pattern of a system whose forward path transfer function is $G(s) = \frac{K}{S(S+2)(S+3)}$ [8M]

6 Sketch the Bode plot and determine the following [16M]
gain cross over frequency
phase cross over frequency
gain margin
phase margin
for then transfer function is given $G(s) = \frac{10(1+0.2S)}{S(S^2+8S+50)}$

7 a) Explain in detail about the electrical circuit diagram that represents the Lag Compensator. [8M]

b) Determine the state controllability and observability of the following system [8M]
$A = \begin{bmatrix} -1 & 0 \\ 0 & -4 \end{bmatrix}, B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}, C = [1 \quad 3]$

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(Normal and semi & polar graph sheet are the suppled)

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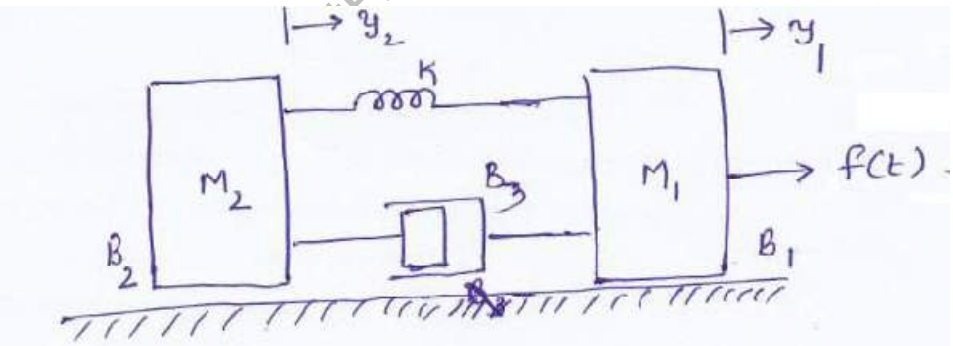
PART –A

1	a)	What are the features of Mathematical Model?	[3M]
	b)	What are the merits of block diagram representation of a system?	[4M]
	c)	explain the unit impulse response of a first order system	[4M]
	d)	What are effects of adding poles to G(s) H(s) on the root loci?	[4M]
	e)	What is polar plot? Draw the polar plot of G(s)=1/(1+ST)	[4M]
	f)	Explain about controllability	[3M]

PART -B

2	a)	Explain the advantages and disadvantages of open loop and closed loop control systems with one example	[8M]
	b)	Write the force equations of the linear translational system shown in figure. Draw the equivalent electrical network using force-voltage Analogy, with the help of necessary mathematical equations.	[8M]



3	a)	Derive the transfer function and develop the block diagram of a AC servo motor.	[8M]
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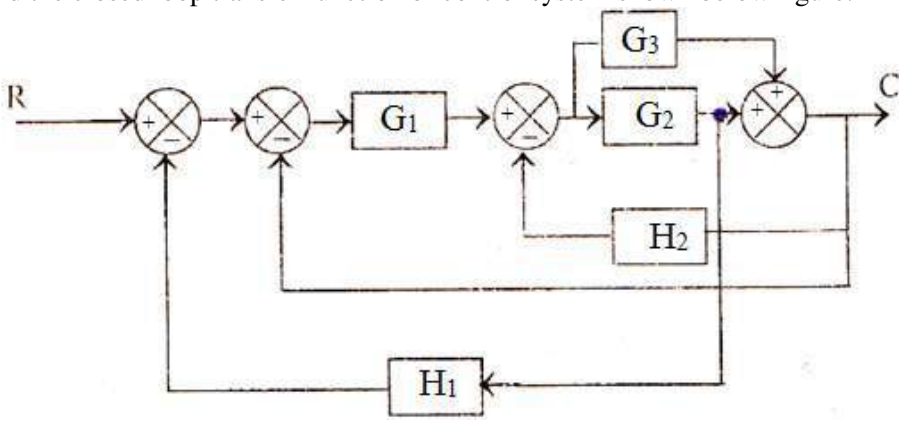
b) Find the closed loop transfer function of control system shown below figure: [8M]



4 a) Find the step, ramp and parabolic error coefficients and their corresponding steady-state errors for unity feedback system having the following transfer function [8M]
$G(S) = \frac{6(S+2)}{S(S+3)(S^2+2S+5)}$.

b) Explain about the PID controller [8M]

5 a) The characteristics equation for a certain feedback control system is given by [8M]
$S^4 + 4S^3 + 7S^2 + 16S + 12 = 0$, Test its stability and find the roots on imaginary axis.

b) Plot the root locus pattern of a system whose forward path transfer function is [8M]

$$G(s) = \frac{K(s+1)}{S(S+2)(S^2+2S+5}$$

6 a) Plot the Bode diagram for the following transfer function and obtain the gain and phase cross over frequencies.G(S) = 10/ S(1+0.4S) (1+0.1S) [8M]

b) Sketch the polar plot for a given open loop function$G(S) = \frac{10}{S(S+1)(S+3)}$. Also find gain margin and phase margin. [8M]

7 system is characterized by the following state space equations [16M]

$$\begin{bmatrix}\dot{X}_1\\ \dot{X}_2\end{bmatrix} = \begin{bmatrix}-3 & 1\\ -2 & 0\end{bmatrix}\begin{bmatrix}X_1\\ X_2\end{bmatrix} + \begin{bmatrix}0\\ 1\end{bmatrix}u;\ \ t > 0$$

$$y = [1 \quad 0]\begin{bmatrix}X_1\\ X_2\end{bmatrix}$$

Find the transfer function of the system.
Compute the state transition matrix.
Solve the state equation for the unit step input under zero initial conditions

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3. Answer any **THREE** Questions from **Part-B**
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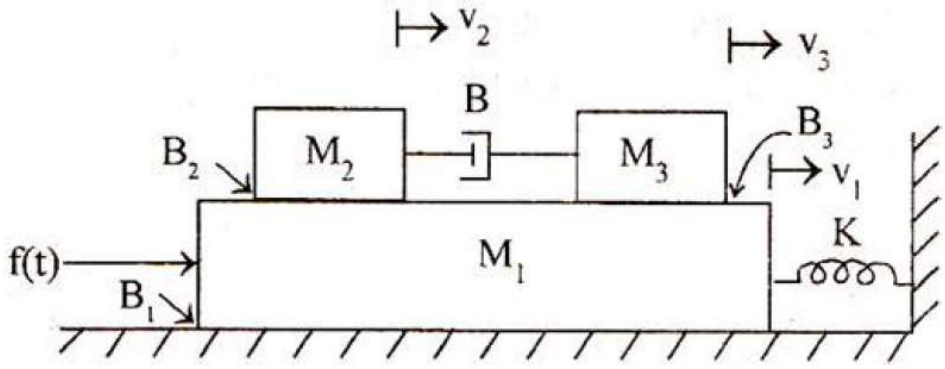
PART –A

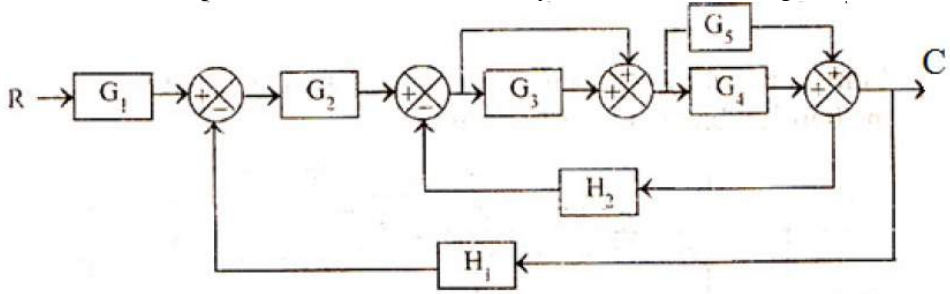
1	a)	Write are the difference in between open-loop and closed-loop control systems.	[3M]
	b)	What are the advantages of transfer function of a system?	[4M]
	c)	What are Standard test signals?	[3M]
	d)	What are asymptotes? How will you find the angle of asymptotes?	[4M]
	e)	What are the features of Polar plots?	[4M]
	f)	What does mean by state model?	[4M]

PART -B

2	a)	Explain the characteristics of feedback.	[8M]
	b)	Determine the transfer function $\frac{V_1(s)}{F(s)}$ for the system show in below figure:	[8M]



3	a)	Derive the transfer function of Synchro Pair.	[8M]
	b)	Find the closed loop transfer function of control system shown below figure:	[8M]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4 a) A certain feedback system is described by the following transfer function $G(s) = \frac{16}{S^2+4S+16}, H(s) = KS$; the damping factor of the system is 0.8. Determine the overshoot of the system. [8M]

b) Determine the error co-efficient and static error for unity and non-unity system$G(s) = \frac{1}{S(S+1)(S+10)}, H(s) = S + 2$ [8M]

5 a) Using Routh-Hurwitz criterion, determine the stability of the closed loop system that has the following characteristic equation and also determine the number of roots that are in the right half s-plane and on the imaginary axis
$3S^4 + 7S^3 + 2S^2 + S + 8 = 0$ [8M]

b) Find the angles of departure and arrival for all complex poles and zeros of the open loop transfer function of $G(s)H(s) = \frac{K(S^2+S+2)}{S(S^2+9)}, K > 0$. [8M]

6 a) Find the Gain margin and phase margin of the system if the open loop transfer function is :$G(S) = \frac{5}{S(S+1)}$ [8M]

b) Draw the polar plot of $G(S)H(S) = \frac{K}{S(S+3)(S+5)}$ and there from determine range of K for stability using Nyquist Criterion. [8M]

7 a) Explain in detail about the electrical circuit diagram that represents the Lead Compensator [8M]

b) Determine the state controllability and observability of the system described by [8M]

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

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

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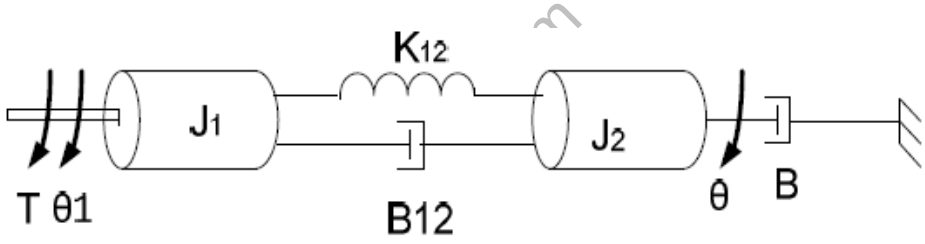
PART –A

1	a)	What are advantages the negative feedback of loop with examples	[3M]
	b)	What are the characteristics of servomotors?	[4M]
	c)	Explain the response of a standard first order system for unit step input.	[4M]
	d)	What are effects of adding zeros to G(s) H(s) on the root loci?	[4M]
	e)	Define phase margin and gain margin.	[4M]
	f)	Why compensation is necessary in feedback control system.	[3M]

PART -B

2	a)	Find transfer function θ(s)/T(s).	[8M]



	b)	Derive the Mason's gain formula of signal flow graph.	[8M]
3	a)	Derive the transfer function and develop the block diagram of field controlled DC servo motor.	[8M]
	b)	Find the transfer function for control function shown below figure using Mason's gain formula	[8M]
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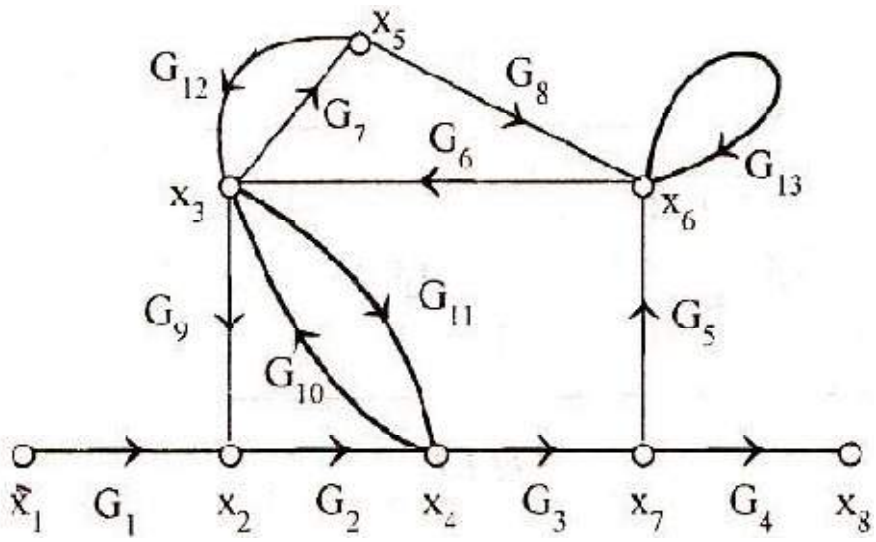

4 a) The closed loop transfer function of unity feedback control system is given by $\frac{C(s)}{R(s)} = \frac{1}{S^2+4S+5}$ Find Damping ratio, natural undamped response frequency, percentage peak overshoot. [8M]

b) For a unity feed-back system whose open loop transfer function is $G(s) = \frac{1}{(1+0.1S)(1+2S)}$, find the position, velocity and acceleration error constants. [8M]

5 a) Using Routh-Hurwitz criterion, determine the stability of the closed loop system that has the following characteristic equation and also determine the number of roots that are in the right half s-plane and on the imaginary axis $S^3 + 2S^2 + S + 8 = 0$ [8M]

b) Find the angles of asymptotes and the intersect of the asymptotes of the root locus of the following equation when K varies from $-\infty$ to ∞ [8M]

$$S^3 + 5S^2 + S + K(S + 1) = 0$$

6 The open loop transfer function of a unity feedback system is given by $\frac{10(S+3)}{S(S+2)(S^2+4S+100}$, draw the bode plot, find the gain margin and phase margin and comment on stability by bode plot. [16M]

7 a) Draw the electrical circuit diagram that represents the Lag-Lead Compensator and explain in detail. [8M]

b) What are the merits and demerits of state variable techniques? [8M]

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