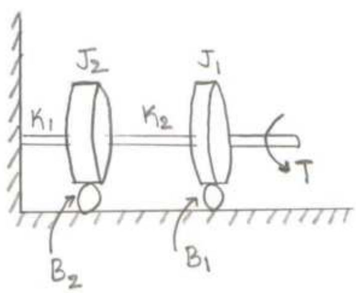
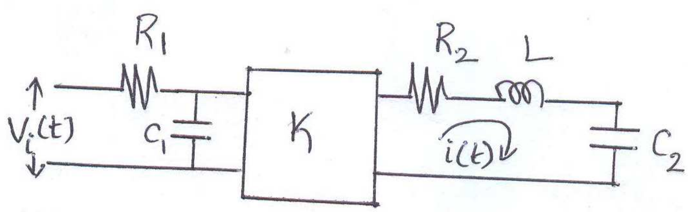
Model Question Paper -1 with effect from 2020-21(CBCS Scheme)

USN | | | | | | | | | |

Fifth Semester B.E. Degree Examination
CONTROL SYSTEMS

TIME: 03 Hours **Max. Marks: 100**

Note: 01. Answer any **FIVE** full questions, choosing at least **ONE** question from each **MODULE**.

Module – 1			
Q.1	**(a)**	Define control system? List the merits and demerits of open loop and closed loop control systems	08
	(b)	What is analogous system? Write the electrical analogous quantities for the mechanical quantities using force-voltage analogy	04
	(c)	For the rotational mechanical system shown in Fig. 1(c). (i) Write the differential equations describing the system (ii) Draw the force-voltage analogous electrical circuit after writing the corresponding electrical equations  Fig. 1(c)	08
OR			
Q.2	**(a)**	For the circuit shown in Fig.2 (a), determine transfer function $I(s)/V_i(s)$, where K is the gain of an ideal amplifier.  Fig.2(a)	08
	(b)	Demonstrate how to perform the following in connection with block diagram reduction rules: (i) Moving a summing point ahead of a block (ii) Elimination of a feedback loop	04
	(c)	For the block diagram of a control system as shown in Fig.2(c), conclude C(s)/R(s) by using block diagram reduction technique.	08

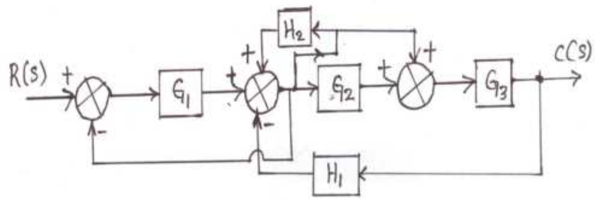


Fig.2(c)

Module – 2

Q.3	**(a)**	Define the following terms as related to signal glow graph with a neat schematic; (i) Source node (ii) Feedback loop (iii) Forward path (iv) Self loop	08
	(b)	Determine the overall gain by using Mason's gain formula of the system described by the signal flow graph shown in Fig.3(b).	12

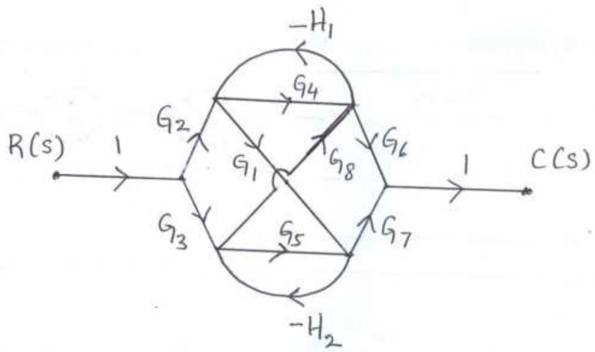


Fig.3(b).

OR

Q.4	**(a)**	Define time response and derive the transient response of a second order system subjected to unit step input.	10
	(b)	For the block diagram shown in Fig.4(b) (i) What type of system does C(s)/R(s) represent? (ii) Find C(s)/R(s) (iii) Determine K_p ,K_v and K_a (iv) Find the steady state output when input r(t)=10u(t)	10

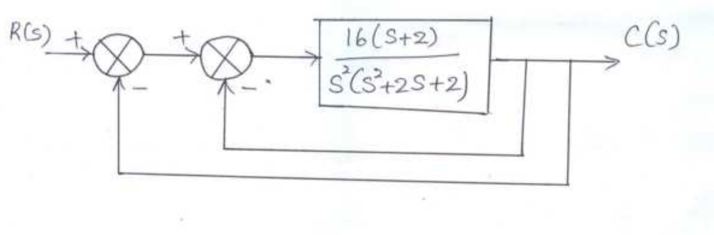
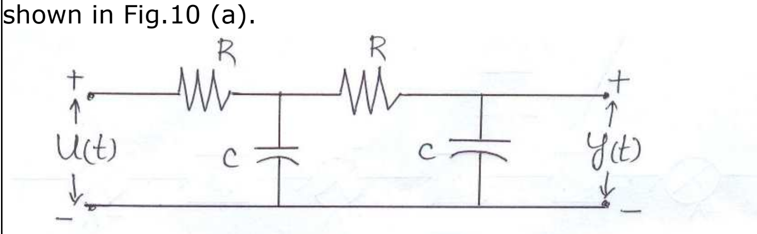


Fig.4(b)

Module – 3

Q.5	**(a)**	Recognize Routh Hurwitz criterion for determining the stability of a system and mention its limitations.	06

	(b)	The open loop transfer function of a unity feedback control system is $G(s)H(s) = \frac{K}{(s+2)(s+4)(s^2+6s+25)}$. Estimate the range of K for stability. What is the value of K which gives sustained oscillations? What is the oscillation frequency?	10
	(c)	For a negative feedback control system , the closed loop transfer function is $\frac{C(s)}{R(s)} = \frac{K}{(s^4+6s^3+30s^2+60s+K)}$ Evaluate the range of K for stability	04
		OR	
Q.6	**(a)**	Define breakaway point and break-in point. Discuss the general predictions about the existence of the same.	08
	(b)	Show the complete root locus diagram for the system whose open loop transfer function is $G(s)H(s) = \frac{K}{s(s^2+2s+2)}$	12
		Module – 4	
Q.7	**(a)**	Determine the frequency domain specifications of a second order system whose closed loop transfer function is $\frac{C(s)}{R(s)} = \frac{64}{(s^2+10s+64)}$	08
	(b)	Elaborate the correlation between time domain and frequency domain specifications	06
	(c)	Illustrate the procedure to evaluate gain margin and phase margin from Bode plots.	06
		OR	
Q.8	**(a)**	State and explain the principle of argument of Nyquist Stability criterion	10
	(b)	The open loop transfer function of a unity feedback control system is $G(s) = \frac{1}{s(1+s)(1+2s)}$. Sketch the Polar plot and determine gain margin and phase margin	10
		Module – 5	
Q.9	**(a)**	Mention the advantages of state variable approach	06
	(b)	Construct the state model for the system represented by a transfer function $\frac{C(s)}{R(s)} = \frac{10}{s(s+2)(s+3)}$	04
	(c)	Define state transition matrix. The state model of the system is given by $\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} -5 & -1 \\ 3 & -1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 2 \\ 5 \end{bmatrix} u$ and $y = \begin{bmatrix} 1 & 2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$ Find the transfer function.	10
		OR	
Q.10	**(a)**	Obtain the appropriate state model for a system represented by electric circuit shown in Fig.10 (a).  Fig.10(a)	08

	(b)	The state equation of a system is given by $\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -6 & -5 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u$ Estimate (i) the state transition matrix (ii) $x_1(t)$ and $x_2(t)$ for a unit step input Assume initial conditions $x_1(0)=1$ and $x_2(0)=0$.	12

Table showing the Bloom's Taxonomy Level, Course Outcome and Programme Outcome

Question		Bloom's Taxonomy Level attached	Course Outcome	Programme Outcome
Q.1	(a)	L2	1	
	(b)	L2	1	
	(c)	L3	1	
Q.2	(a)	L4	1	
	(b)	L2	2	
	(c)	L4	2	
Q.3	(a)	L2	2	
	(b)	L3	2	
Q.4	(a)	L2	3	
	(b)	L4	3	
Q.5	(a)	L2	5	
	(b)	L4	5	
	(c)	L3	5	
Q.6	(a)	L2	5	
	(b)	L2	5	
Q.7	(a)	L4	5	
	(b)	L2	5	
	(c)	L2	5	
Q.8	(a)	L2	5	
	(b)	L5	5	
Q.9	(a)	L2	4	
	(b)	L3	4	
	(c)	L4	4	
Q.10	(a)	L3	4	
	(b)	L5	4	

Bloom's Taxonomy Levels	**Lower order thinking skills**		
	Remembering(knowledge):L_1	Understanding Comprehension): L_2	Applying (Application): L_3
	Higher order thinking skills		
	Analyzing (Analysis): L_4	Valuating (Evaluation): L_5	Creating (Synthesis): L_6

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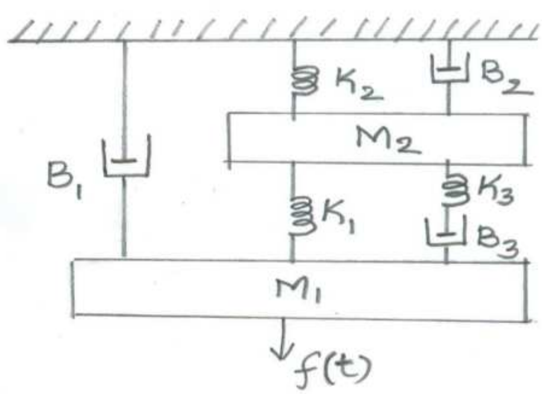
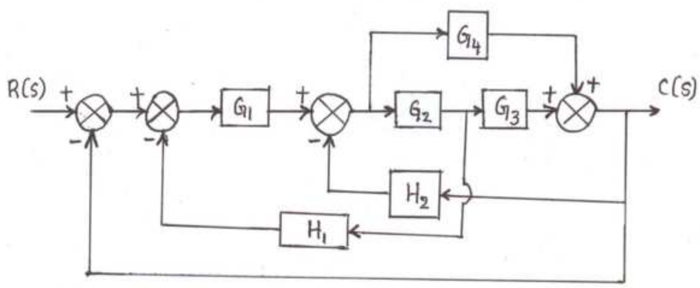
Model Question Paper -2 with effect from 2020-21(CBCS Scheme)

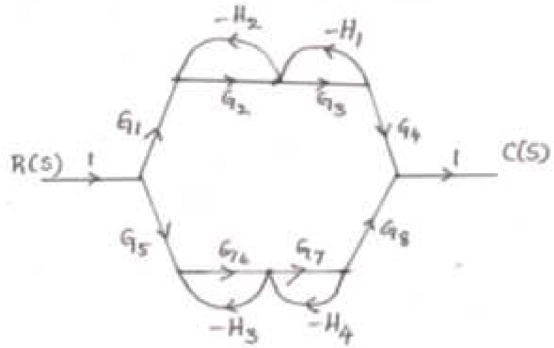
USN | | | | | | | | | | |

Fifth Semester B.E. Degree Examination
CONTROL SYSTEMS

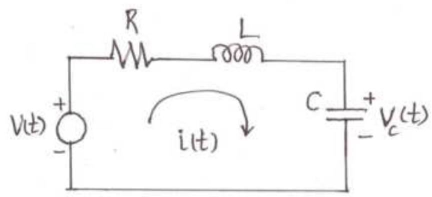
TIME: 03 Hours **Max. Marks: 100**

Note: 01. Answer any **FIVE** full questions, choosing at least **ONE** question from each **MODULE**.

		Module – 1	
Q.1	**(a)**	List and discuss the different types of control systems	08
	(b)	What are the elements associated to translational mechanical system? For the mechanical system shown in Fig.1(b) (i) Draw the equivalent mechanical network (ii) Write the differential equations describing the system (ii) Draw the force-voltage and force-current analogous electrical circuits after writing the corresponding electrical equations  Fig.1(b)	12
		OR	
Q.2	**(a)**	Illustrate the various block diagram reduction techniques	10
	(b)	Reduce the block diagram as shown in Fig.2(b) to single block M(s)=C(s)/R(s) by using block diagram reduction techniques  Fig.2(b)	10

		Module – 2	
Q.3	**(a)**	State and explain Mason's gain formula. Determine the transfer function C(s)/R(s) for the signal flow graph shown in the Fig.2(b), using the same.  Fig.2(b)	12
	(b)	Draw the signal flow graph for the following equations and obtain overall transfer function using Mason's Gain formula: $X_1=R-x_6$; $x_2=x_1-x_4H_2$; $x_3=G_1x_2$; $x_4=G_2x_3$; $x_5=x_4-H_1x_6+G_4x_3$; $x_6=x_5G_3$;$C=x_6$	08
		OR	
Q.4	**(a)**	Name the standard test signals used in control systems? How are they defined mathematically? Represent their Laplace transformations?	06
	(b)	Define the steady state error constants. The open loop transfer function of a unity feedback control system is $G(s)=\frac{100}{s^2(s+4)(s+12)}$. Calculate(i)Static error constants and (ii) the steady state error for the input $r(t)=2t^2+5t+10$	07
	(c)	A negative feedback control system has a forward path transfer function, G(s)=K/s(s+1), and feedback path transfer function, H(s)=1+as. If this system is to have a peak time of 0.5 seconds, a 10% overshoot for a unit step input, determine K and a.	07
		Module – 3	
Q.5	**(a)**	Define (i) Absolute stability (ii)Relative stability	04
	(b)	Depict the transfer function, time response and location of roots in the s-plane for stability analysis.	08
	(c)	Test the stability of a system, $s^6+2s^5+8s^4+12s^3+20s^2+16s+16=0$.Find the number of roots of this equation lie on right half of the s-plane, on left half of the s-plane and on the imaginary axis.	08

		OR	
Q.6	**(a)**	Clarify the magnitude and angle conditions as applied to root locus method	06
	(b)	Mention the merits of Root locus technique	04
	(c)	Sketch the root locus plot for a negative feedback control system whose open loop transfer function, $G(s)H(s)=K/s(s+3)(s^2+2s+2)$ for all values of K ranging from 0 to ∞. Also find the value of K for a damping ratio of 0.5	10
		Module – 4	
Q.7	**(a)**	Interpret the Correlation between the time and frequency domain specifications	06
	(b)	Deliberate the nature of Bode plot of (i) Pole at the origin (ii) Simple pole	06
	(c)	Construct the Bode's diagram for a system having open loop transfer function as G(s)H(s) =10(1+0.1s)/s(1+0.5s)(1+0.2s). From the diagram, find gain cross over frequency, phase cross over frequency, gain margin and phase margin. Comment on its stability .	08
		OR	

Q.8	**(a)**	Given $G(s)H(s)=\frac{12}{s(s+1)(s+2)}$. Draw the polar plot and hence determine if system is stable and its gain margin and phase margin	10
	(b)	State and explain the principle of argument of Nyquist Stability criterion	10
Module – 5			
Q.9	**(a)**	Define (i) State (ii) State variable	04
	(b)	Relate the state model for the system described by the differential equation as $4\frac{d^3}{dt^3}y(t)+2\frac{d^2}{dt^2}y(t)+\frac{d}{dt}y(t)+2y(t)=5u(t)$	06
	(c)	Evaluate the state transition matrix for the system: $\ddot{y}+3\dot{y}+2y=0$. Also find the inverse of the state transition matrix.	10
OR			
Q.10	**(a)**	Develop the mathematical procedure to find the solution of the state equation	04
	(b)	Obtain the state model and output model of the electrical system as shown in Fig.10(b)  Fig.10(b)	06
	(c)	The state model of the system is given by $\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix}=\begin{bmatrix}0 & 2\\ -3 & -5\end{bmatrix}\begin{bmatrix}x1\\ x2\end{bmatrix}+\begin{bmatrix}0\\ 1\end{bmatrix}e^{-t}$; $y=[1\ \ 3]x$ and $x[0]=\begin{bmatrix}2\\ 1\end{bmatrix}$ Solve for y(t)	10

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	(c)	L4	4	
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