Reg. No: | | | | | | | | | | |

SETHU INSTITUTE OF TECHNOLOGY, KARIAPATTI

(An Autonomous Institution, Affiliated to Anna University, Chennai)

Regulation - 2015

B.E/B.TECH DEGREE END SEMESTER EXAMINATIONS – DEC 2020

FIFTH SEMESTER

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

15UEC904 – LINEAR CONTROL ENGINEERING

Answer ALL questions

Duration: 3 Hrs	**Maximum mark: 100**

UNIT -1

PART -- A (8 x 1 = 8Marks)

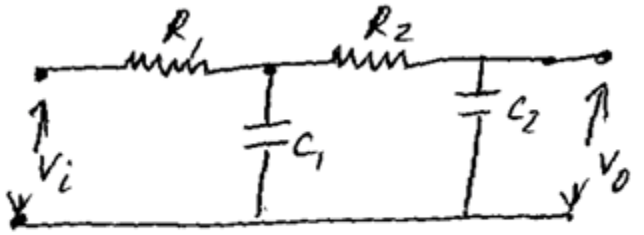
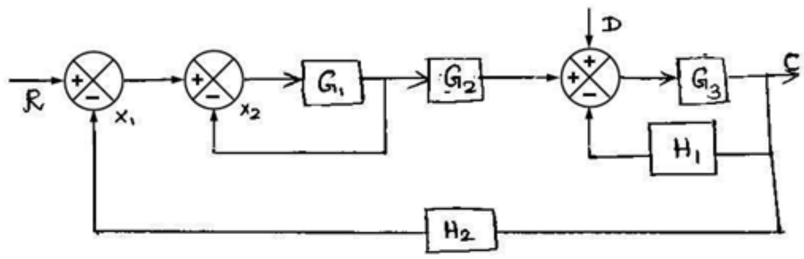
1	A control system in which the control action is somehow dependent on the output is known as (a) Closed loop system b)Open loop system c)Semi closed loop system d)None the above
2.	In closed loop control system, with positive value of feedback gain the overall gain of the system will a) Decrease b) Increase c) be unaffected d) any of the above
3.	Which of the following is an open loop control system? (a) filed controlled DC motor (b) Ward Leonard control (c) Metadyne (d) Stroboscope
4.	In open loop system a) the control action depends on the size of the system b) the control action depends on system variables c) the control action depends on the input signal d) the control action is independent of the output
5.	The transfer function is applicable to which of the following? (a) Linear and time-in variant systems (b) Linear and time-variant systems (c) Linear systems (d) Non-linear systems
6.	Zero initial condition for a system means (a) Input reference signal is zero (b) zero stored energy (c) One initial movement of moving parts (d) system is at rest and no energy is stored in any of its components

7.	What is the effect of negative feedback on the gain of an amplifier (a) It reduces the gain by a factor of 1/B. (b) It increases the gain by a factor of (1 + AB). (c) It increases the gain by a factor of 1/B. (d) It reduces the gain by a factor of (1 + AB).
8.	Loop which do not possess any common node are said to be ___________ loops. (a) Forward gain b) Touching loops c) Non touching loops d) Feedback gain.

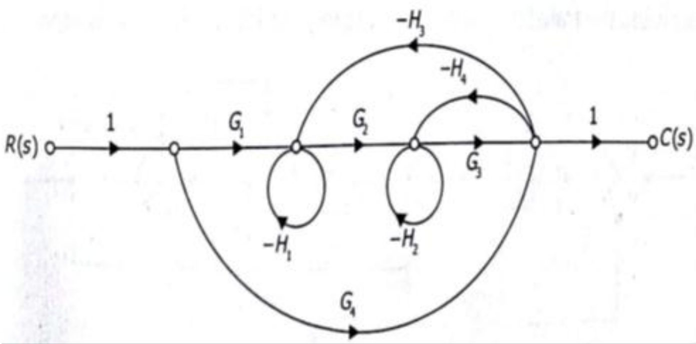
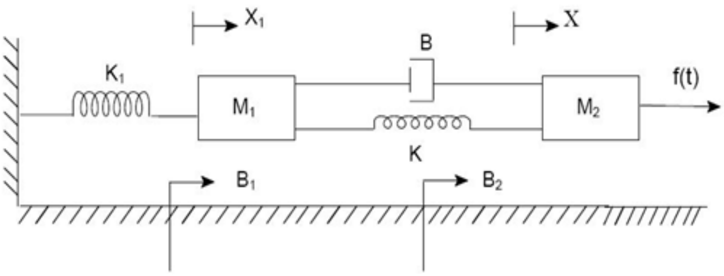
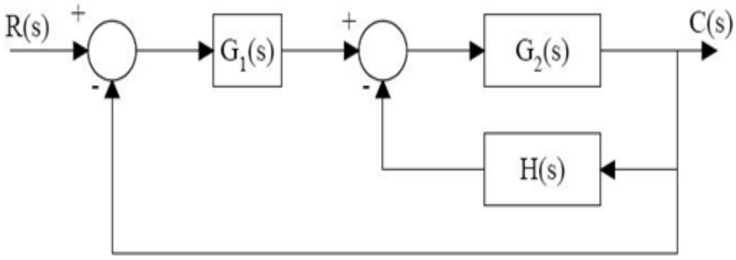
PART -- B (5 x 2 = 10 Marks)

1.	State Mason's gain formula. (CO1,U)
2.	Compare the Open loop System with Closed loop System. (CO1, U)
3.	Illustrate any two rules to be followed in block diagram reduction techniques. (CO1, U)
4.	Negative feedback is preferred in control system. Justify. (CO1,U)
5.	Discuss about the block diagram and its components of a control system. (CO1,U)

PART -- C (5 x 8 = 40 Marks)

.1	(a)	Estimate the Transfer function of the electrical network shown in the fig. (CO1,Apply) 	
2	(b)	For the block diagram shown below, inspect the output C/R. (CO1, Apply) 	
3		Using signal flow graph, analyze the overall Transfer function for the system shown in the fig. (CO1, Apply)	

4.

			
4		Demonstrate the differential Equations governing the mechanical system shown in the fig. and determine the transfer function. (CO1, Apply) 	
5.		Estimate the overall transfer function of the system shown in the fig. (CO1,Apply) 	

UNIT -II

PART -- A (8 x 1 = 8Marks)

1	The type 0 system has ___________ at the origin a. no pole b. net pole c. simple pole d. none of the above
2.	Velocity error constant of a system is measured when the input to the system is unit _______ function a. Parabolic b. ramp c. impulse d. step
3.	The damping ratio and peak overshoot are measures of: a) Relative stability b) Speed of response c)Steady state error d) Absolute stability
4.	The steady state error of a stable 'type 0' unity feedback system for a unit step function is

	(a) 0 b. $\frac{1}{1+K_P}$ c. ∞ d. $\frac{1}{K_P}$
5.	For a second order system, damping ratio (ξ) is $0 < \xi < 1$, then the roots of the characteristic polynomial are (a) real but not equal (b)real and equal (c) complex conjugates (d)imaginary
6.	On which factor does the steady state error of the system depend? a. Order b. Type c. Size d. Prototype
7.	The position and velocity error of a Type-2 systems are a) constant, constant (b) constant, infinity (c) zero, constant (d) zero, zero.
8.	A system has a single pole at origin. Its impulse response will be: (a) Constant (b) Ramp (c) Decaying exponential (d) Oscillatory
	PART -- B (5 x 2 = 10 Marks)
1.	Determine the Damping ratio and natural frequency of oscillation for the closed loop transfer function of a second order system is given by (CO2, Apply) $G(s) = \frac{400}{s^2 + 2s + 400}$
2.	Illustrate how a control system is classified depending on the value of damping ratio? (CO2,U)
3.	The damping ratio and natural frequency of a second order system are 0.5 and 8 rad/sec respectively. Calculate resonant peak and resonant frequency. (CO2, Apply)
4.	Define damping ratio. (CO2, R)
5.	A unity feedback system has a open loop transfer function of G(s)=10/(s+1)(s+2). Determine the steady state error for unit step input. (CO2,Apply)
	PART -- C (5 x 8 = 40 Marks)

1		The open loop transfer function of a unity feedback system is given by *G(s)=K/s(Ts+ 1)* where K and T are positive constants. By what factor should the amplifier gain be reduced so that the peak overshoot of unit step response of the system is reduced from 75% to 25. (CO2, Ananlyze)
2		A unity feedback control system has an open loop transfer function *G(S) = 10/s(s+2)*. Find the rise time, percentage over shoot, peak time and settling time. (CO2,Apply)
3		Derive the response of under damped second order system for unit step input. (CO2, U)
4		An unit feedback system has *G(s) =1/s(1+2s)*. The input to the system is described by $r(t)=2+4t+6t^2+2t^3$. Determine the generalized error coefficients and express the steady state error as a function of time. (CO2, Apply)
5.		A unity feedback system with unit step input for which open loop transfer *G(s) = 16/s(s+8)*. Solve for the transfer function, the natural Frequency, the damping ratio and the Damped frequency of oscillation and Calculate the delay time, rise time and peak overshoot. (CO2,Apply)

UNIT -III	
PART -- A (8 x 1 = 8Marks)	
1	By equating the denominator of transfer function to zero, which among the following will be obtained? a. Poles b. Zeros c. Both a and b d. None of the above
2.	The magnitude & phase relationship between _________input and the steady state output is called as frequency domain. a) Step b. Ramp c. Sinusoidal d. Parabolic
3.	Which unit is adopted for magnitude measurement in Bode plots? a. Degree b. Decimal c. Decibel d. Deviation
4.	In polar plots, what does each and every point represent with respect to magnitude and angle? a)Scalar b. Vector c. Phasor d. Differentiator
5.	Due to an addition of pole at origin, the polar plot gets shifted by ___ at ω = 0? a. -45° b. -60° c. -90° d. -180°
6.	The phase lag produced by transportation relays a. is independent of frequency b. is inversely proportional to frequency c. increases linearly with frequency d. decreases linearly with frequency
7.	Phase margin of a system is used to specify which of the following? a. frequency response b. absolute response c. relative stability d. time response
8.	If the system is represented by *G(s) H(s) =k(s+7)/s(s+3)(s+2)*, what would be its magnitude at w=∞? a. 0 b. ∞ c. 7/10 d. 21
PART -- B (5 x 2 = 10 Marks)	
1.	Determine the gain crossover frequency of the transfer function K/s^2. (CO3, Apply)
2.	What are the advantages of Bode plot? (CO3, U)
3.	Summarize the advantages of Frequency Response Analysis. (CO3, U)
4.	Mention gain crossover Frequency. (CO3, R)
5.	Define Phase margin & gain margin. (CO3,R)

PART -- C (5 x 8 = 40 Marks)

.1		Given $G(s)=\dfrac{ke^{-0.2s}}{s(s+2)(s+8)}$ (CO3,Analyze) Draw the Bode plot and find K for the following two cases: (i) Gain margin equal to 6db (ii) Phase margin equal to 45°
2		Consider a unity feedback system having an open loop transfer function (CO3, Analyze)

		$G(s)=\frac{K}{s(s+0.5s)(1+4s)}$ Outline the polar plot and determine the value of K so that (i) Gain margin is 20db (ii) Phase margin is 30°.
3		Sketch the polar plot and find the gain and phase margin of a control system has with unity feedback $G(s)=\frac{1}{s^2(s+1)(1+2s)}$. (CO3, Apply)
4		For the $G(s)=\frac{5(1+2s)}{(1+4s)(1+0.25s)}$ Estimate the value of phase and gain margin using bode plot. (CO3, Apply)
5.		Report the value of gain and phase cross over frequencies for the following function using bode plot. $G(s)=\frac{10}{s(1+0.4s)(1+0.1s)}$. (CO3, Apply)

UNIT -IV

PART -- A (8 x 1 = 8Marks)

1	Technique gives quick transient and stability response (a)Root locus (b)Bode (c)Nyquist (d)Nichols
2.	Root locus specifies the movement of closed loop poles especially when the gain of system _______ (a) Remains constant (b) Exhibit variations (c)Gives zero feedback (d) Gives infinite poles
3.	The type 2 system has at the origin. (a) no net pole (b) net pole (c) Simple pole (d) two poles
4.	A conditionally stable system exhibits poor stability at (a) Low frequencies (b) reduced values of open loop gain (c) Increased values of open loop gain (d) None of the above
5.	For the polynomial $R(s)= s^5+s^4+2s^3+2s^2+3s+15=0$ the number of roots which lie in the right half of S plane is (a) 4 (b) 3 (c) 2 (d)1
6.	The root locus of the system $G(s)H(s)= K/s(s+2)(s+3)$ has the breakaway point located at (a) (-0.5,0) (b) (-2.548,0) (c) (-4,0) (d) (-0.748,0)
7.	Given G(s) H(s)= K/s(s+1)(s+3) the point of intersection of the asymptotes of the root loci with the real axis (a) 4 (b) -1.33 (C) -4 (d) 1.33

8.	The number of open right half plane poles $G(s)= 10/s^5+2s^4+3s^3+6s^2+5s+3$ is (a) 3 (b) 2 (C) -1 (d) 0	

PART -- B (5 x 2 = 10 Marks)

1.	Illustrate any two limitations of Routh-stability criterion. (CO4, U)
2.	Explain stability of a system. (CO4, R)
3.	What is the advantage of using root locus for design? (CO4, U)
4.	Express the rules to obtain the breakaway point in root-locus. (CO4, U)
5.	What is Centroid? (CO4,R)

PART -- C (5 x 8 = 40 Marks)

.1		Discuss the stability of a system with characteristics equation $s^4+s^3+20s^2+ 9s +100 = 0$ Using Routh Hurwitz criterion. (CO4, Apply)
2		Using Routh Hurwitz criterion determine the stability of a system representing the characteristic equation $s^6+2s^5+8s^4+12s^3+20s^2+16s+16=0$ and comment on location of the roots of the characteristic equation. (CO4, Apply)
3		Label the Root Locus of the System whose open loop transfer function is $G(s)=\dfrac{K}{s(s+1)(s+3)}$. Determine the Value of K for Damping Ratio equal to 0.5. (CO4, Analyze)
4		Draw the root locus of the $G(s)=\dfrac{K(s+2)}{s^2+2s+3}$ whose $H(s) = 1$. Determine open loop gain k at $\delta = 0.7$. (CO4, Analyze)
5.		The open loop transfer function of a unity feedback system given by $G(s)=\dfrac{K(s+9)}{s(s^2+4s+11)}$. Sketch the root locus of the system and the evaluate the system stability with respect to their location of poles. (CO4, Analyze)

UNIT -V

PART -- A (8 x 1 = 8Marks)

1	State space analysis is applicable even if the initial conditions are _____ (a) Zero (b) Non-zero (c) Equal (d) Not equal

2.	Which among the following plays a crucial role in determining the state of dynamic system? (a) State variables (b) State vector (c) State space (d) State scalar
3.	Which among the following constitute the state model of a system in addition to state equations? (a)Input equations (b).Output equations (c) State trajectory (d) State vector
4.	State model representation is possible using __________ (a) Physical variables b) Phase variables (c) canonical state variables (d) all the above
5.	Which among the following is a unique model of a system? (a)Transfer function (b) State variable (c)Both a and b (d) None of the above
6.	According to the property of state transition method, e0 is equal to _____ (a) I (b). A (c). e^{-At} (d) $-e^{At}$
7.	Which mechanism in control engineering implies an ability to measure the state by taking measurements at output? (a). Controllability (b) Observability (c)Differentiability (d) Adaptability
8.	Which among the following is a disadvantage of modern control theory? (a) Implementation of optimal design (b) Transfer function can also be defined for different initial conditions (c)Analysis of all systems take place (d) Necessity of computational work
PART -- B (5 x 2 = 10 Marks)	
1.	Name the methods of state space representation for phase variables. (CO5, R)
2.	Describe State and State Variable. (CO5,U)
3.	Explain the concept of Controllability. (CO5,U)
4.	Distinguish type and order of the system. (CO5, U)
5.	Propose the need for State variables. (CO5,U)
PART -- C (5 x 8 = 40 Marks)	

.1		The State model matrices of a system are given below $A=\begin{bmatrix}0 & 1 & 0\\0 & 0 & 1\\0 & -2 & -3\end{bmatrix};B=\begin{bmatrix}0\\0\\1\end{bmatrix}$ and $C=[\ 3 \quad 4 \quad 1]$ .Generalize the Observability of the System using Gilberts test. (CO5, Apply)
2		Determine the state variable representation of the system whose transfer function is given as $\frac{Y(s)}{U(s)}=\frac{2s^2+8s+7}{(s+2)^2(s+1)}$. (CO5, Analyze)
3		A system is represented by State equation *X= AX+BU; Y=CX* Where $A=\begin{bmatrix}0 & 1 & 0\\0 & -1 & 1\\0 & -1 & -10\end{bmatrix};B=\begin{bmatrix}0\\0\\10\end{bmatrix}$ and $C=[\ 1 \quad 0 \quad 0]$

		Inspect the Transfer function of the System. (CO5, Apply)
4		Develop the Transfer function of the matrix from the data given below (CO5, Apply) $A=\begin{bmatrix} -3 & 1 \\ 0 & -1 \end{bmatrix}; B=\begin{bmatrix} 1 \\ 1 \end{bmatrix}; C=\begin{bmatrix} 1 & 2 \end{bmatrix}$ and D=0.
5.		Develop the Transfer function of the matrix from the data given below $\frac{Y(s)}{U(s)}=\frac{s+2}{s^3+9s+26s+24}$ and Analyze the controllability of the system. (CO5,Analyze)