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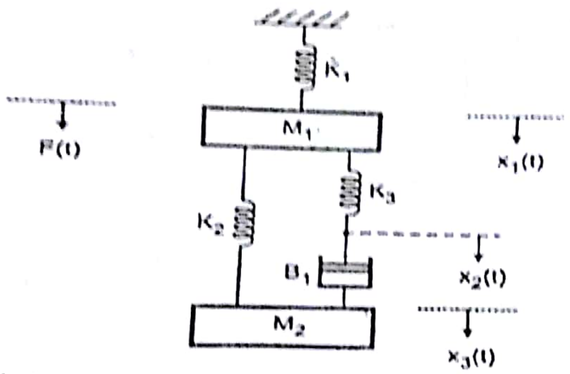
EEE Dept.
Exam.
Internal Assessment
EvenSem(2017-18)

FIRST INTERNAL ASSESSMENT

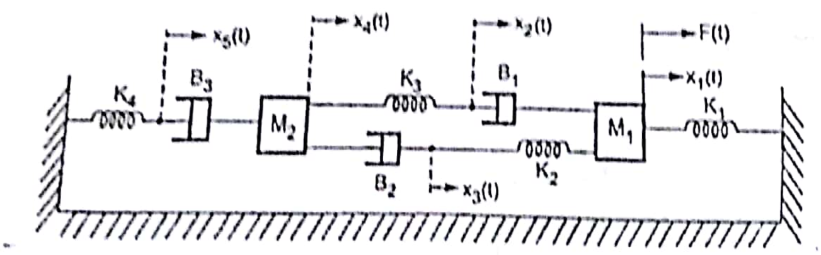
Sem :VI **Sub: Control System** **Sub. Code: 15EE61**
Date:05/03/2018 **Time:11:00AM-12.00PM** **Max. Marks: 25**

Note: Answer two full questions, draw sketches wherever necessary.

Q. No		Discription of Question	Marks	CO	RBT L
1	a	For the mechanical system shown, Obtain the analogous electrical network based on force-Voltage analogy.	6	CO315. 1	L4

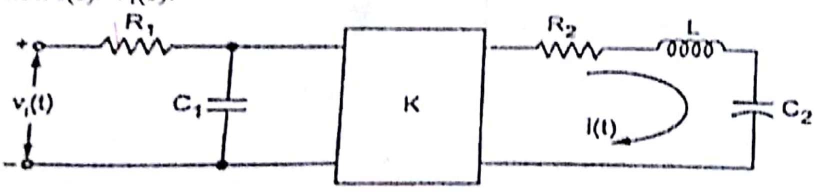


	b	For the mechanical system shown, Obtain the analogous electrical network based on Force-Voltage analogy.	7	CO315. 1	L4

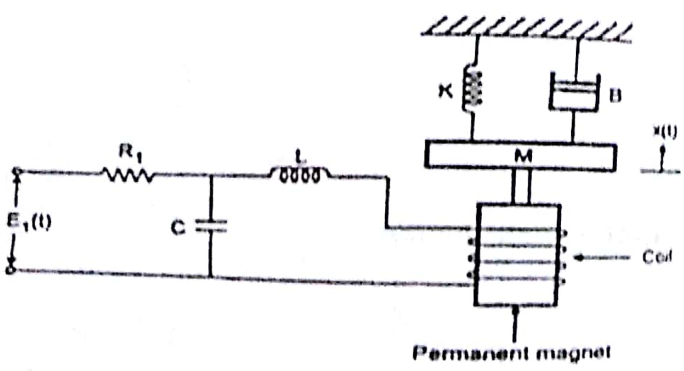


OR

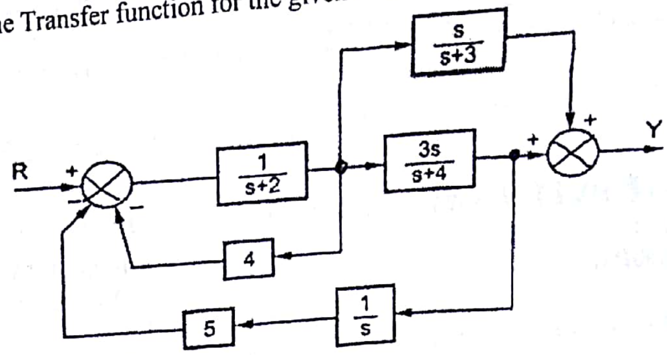
	a	In the circuit, K is the gain of an ideal amplifier. Determine the Transfer function $I(s)/V_i(s)$.	6	CO315. 1	L4



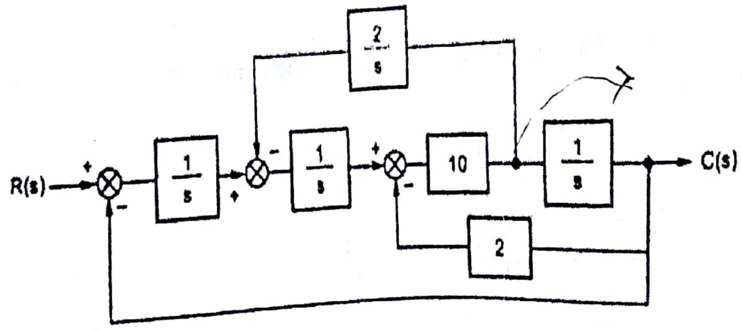
	b	Find the Transfer function. $X(s)/E_i(s)$	7	CO315. 1	L4



3 a Determine Transfer function for the given block diagram. 6 CO315.2 L4

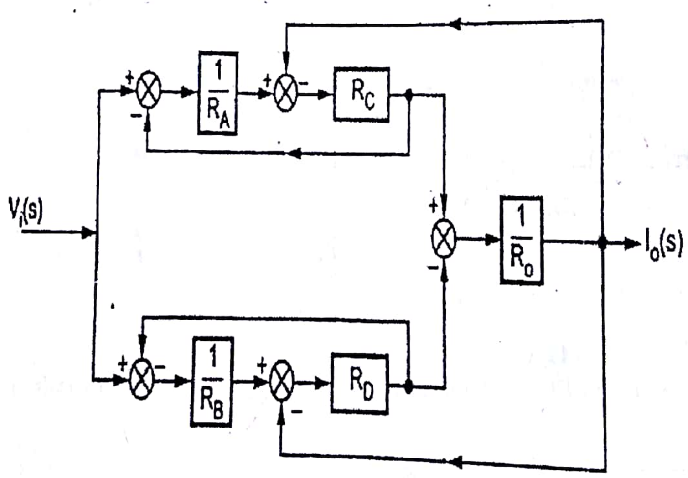


b Determine Transfer function for the given block diagram. 6 CO315.2 L



OR **(For 4th question only 1 option)**

4 a Determine Io(s)/Vi(s) for the given block diagram 12 CO315.2

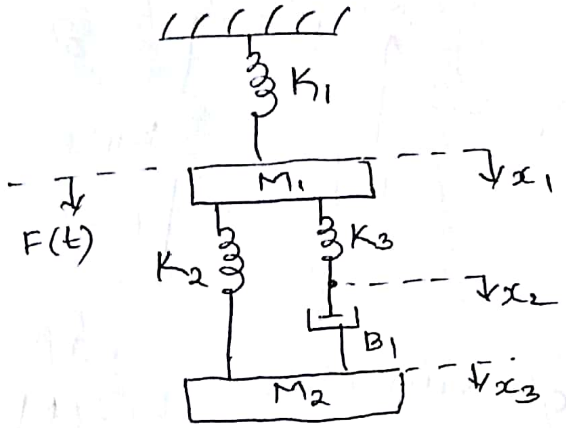


Course Coordinator **Module Coordinator** **HOD**

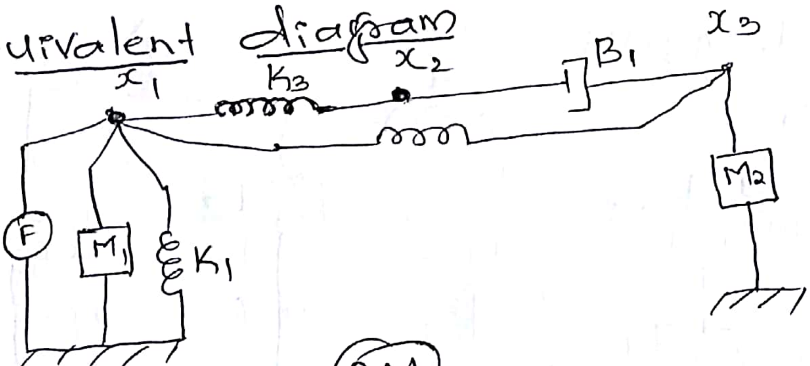
SCHEME OF EVALUATION

Sem : VI | Subject : Control System | Sub Code : 15EE61 | Date : 5/3/

Q. No.	Bit	Description	Marks	CO's
Q1	a	Obtain analogous electrical network based on force voltage analogy.	6	315.1



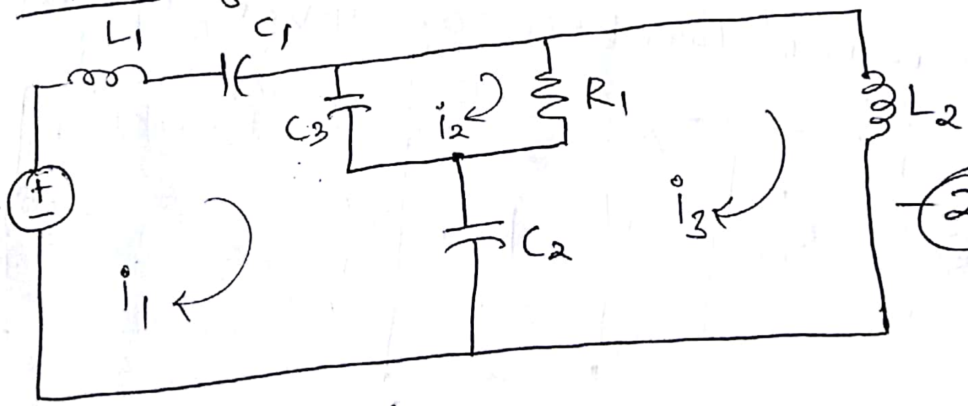
Equivalent diagram



— 2M

Equations — 2M

F-V diagram



— 2M

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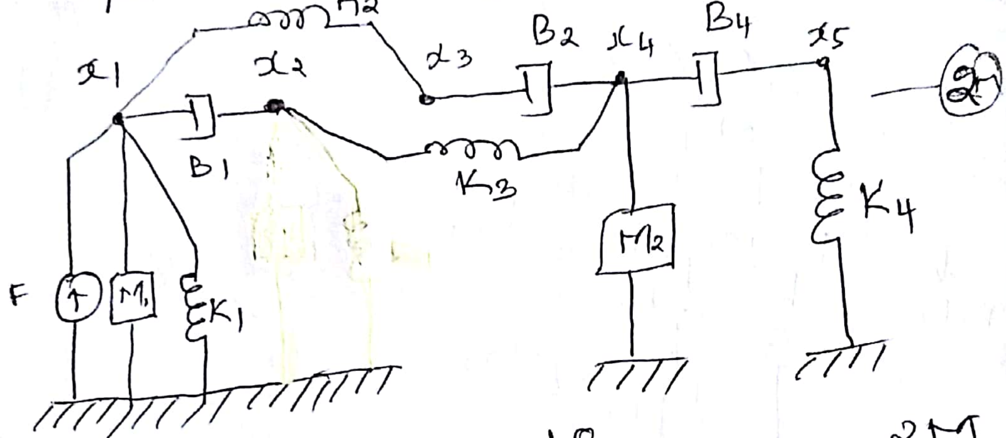
SCHEME OF EVALUATION

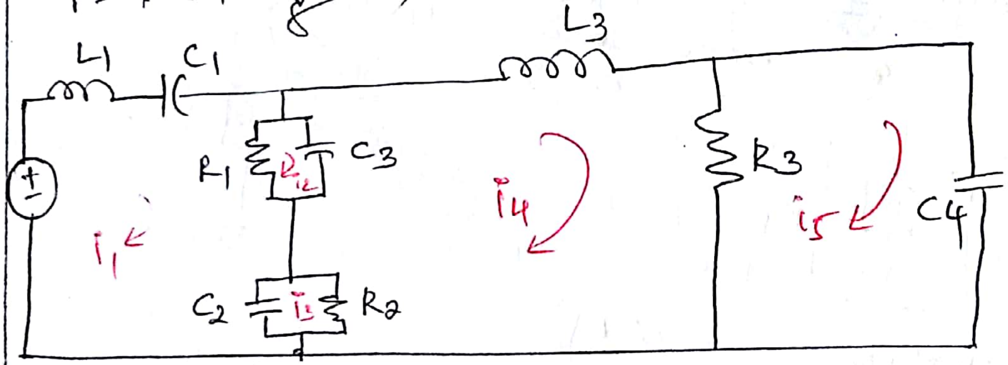
Sem :	Subject :	Sub Code :	Date :

Q. No.	Bit	Description	Marks	CO
Q1	b)	Equivalent diagram	7	3/C



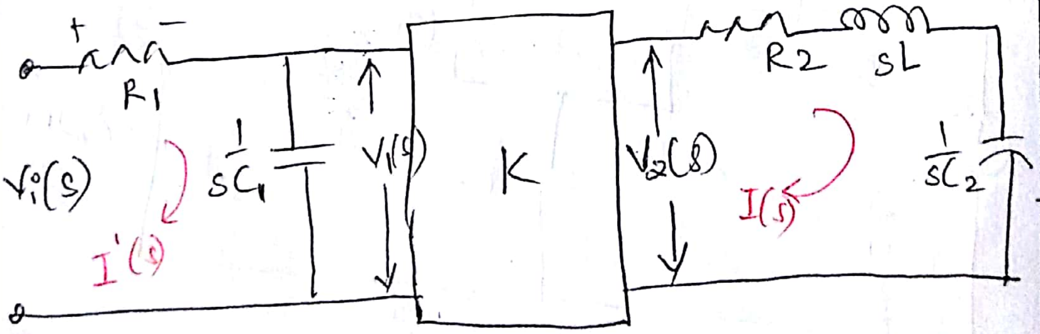
Equilibrium equations ——— 2M

F-V diagram ——— 2M



Q2 a) T.F = I(s) / Vi(s)

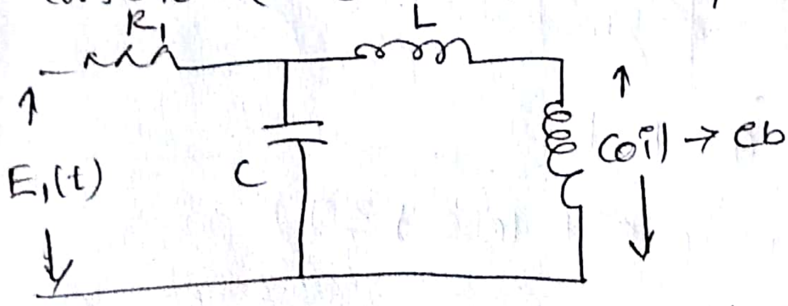
Taking Laplace of given circuit



— 2M

SCHEME OF EVALUATION

Subject : | Sub Code : | Date :

Q. No.	Bit	Description	Marks	CO's
		KVL to left side		
		$V_i(s) = I_1'(s)R_1 + \frac{I'(s)}{sC_1}$ --- (1)	(1M)	CO315.2
		$V_1(s) = I'(s)\frac{1}{sC_1}$		
		KVL to Right side		
		$V_2(s) = I(s)R_2 + sL\,I(s) + \frac{1}{sC_2}I(s)$	(1M)	
		$V_2(s) = K\,V_1(s)$		
		$\frac{I(s)}{V_i(s)} = \frac{KsC_2}{(1+sC_1R_1)(1+sC_2R_2+s^2LC_2)}$	(2M) 6M	
Q2	b)	consider electrical system		
				
		Laplace $E_1(s) = I_1(s)R_1 + \frac{1}{sC}[I_1(s) - I_2(s)]$	2M	CO315.
		$0 = sL\,I_2(s) + \frac{1}{sC}[I_2(s) - I_1(s)] + E_b(s)$		
		$e_b = K_b \cdot s \cdot X(s)$		

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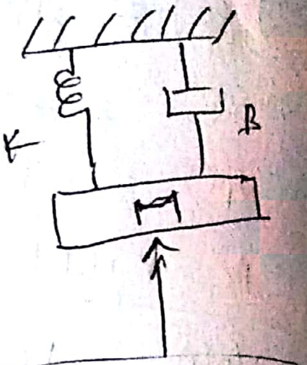
F(t) is produced because of flux due to current I_a



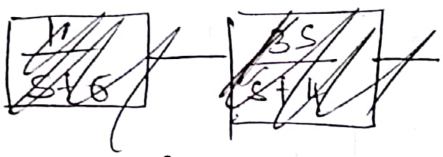
$F(s) = K_i I_a(s)$ 2

$F(s) = X(s)[Ms^2 + Bs + K]$

Subst — 3M

$$\frac{X(s)}{E_1(s)} = \frac{K_i}{[(Ms^2+Bs+K)(s^2+LCR_1+sL+R_1) + K_i K_b s(1+sCR_1)]}$$ 7M

Q3 a)



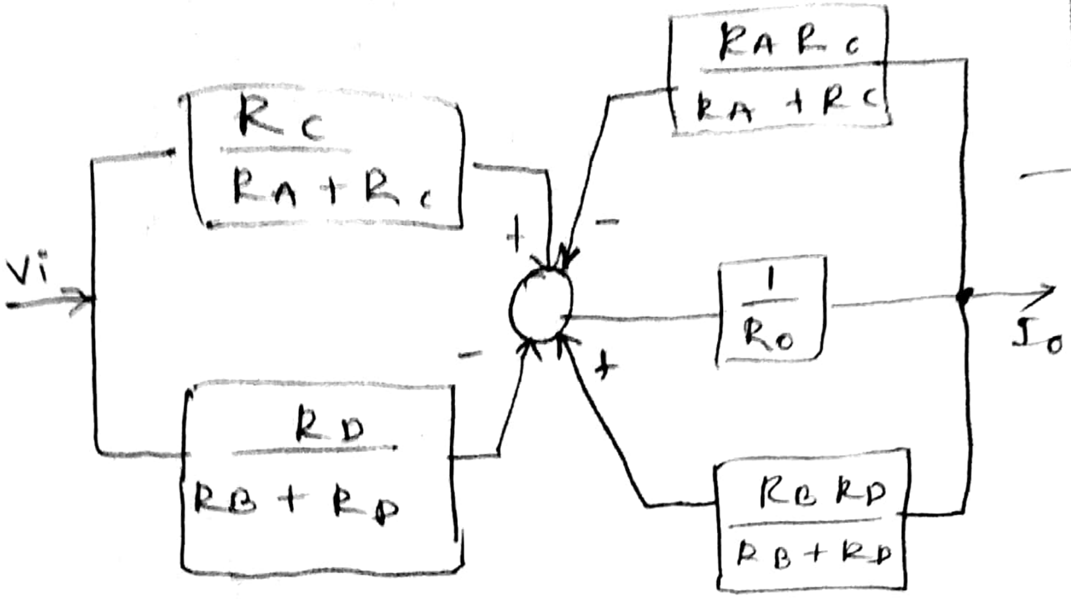
$$\frac{Y}{R} = \frac{s(4s+13)}{(s+3)(s^2+10s+39)}$$ 6M

b)

$$\frac{C}{R} = \frac{10}{s^3+20s^2+20s+10}$$ 6M

SCHEME OF EVALUATION

Subject : | Sub Code : | Date :

Q. No.	Description	Marks	CO's
a)		5M	CO315.2
	$= \dfrac{R_C R_B - R_D R_A}{\{(R_B + R_D)(R_o R_A + R_o R_C + R_A R_C) - R_B R_D (R_A + R_C)\}}$	7M	
		12M	

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Exam
Internal Assessment
EvenSem(2017-18)

SECOND INTERNAL ASSESSMENT

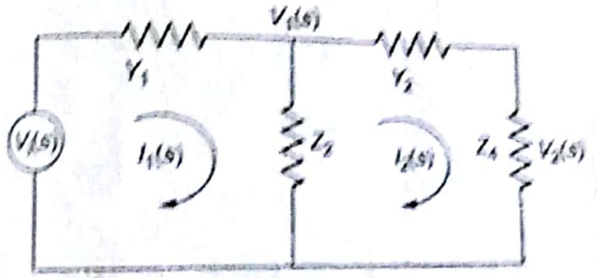
Sem :VI
Date:11/04/2018

Sub: CONTROL SYSTEM
Time:11:00AM-12.00PM

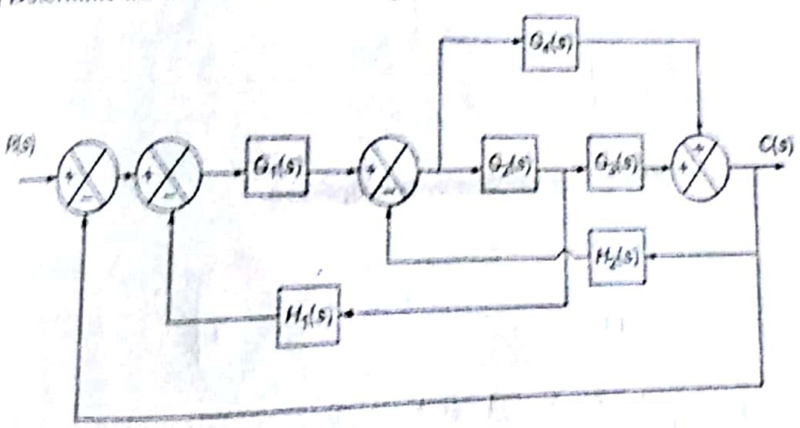
Sub. Code: 15EE61
Max. Marks: 25

Note: Answer two full questions, draw sketches wherever necessary.

Q. No		Discription of Question	Marks	CO	RBTL
1	a	For the electrical circuit shown, determine the transfer function of the system $V_2(s) / V_1(s)$ using Mason's gain Formula.	6	CO315. 1	L4

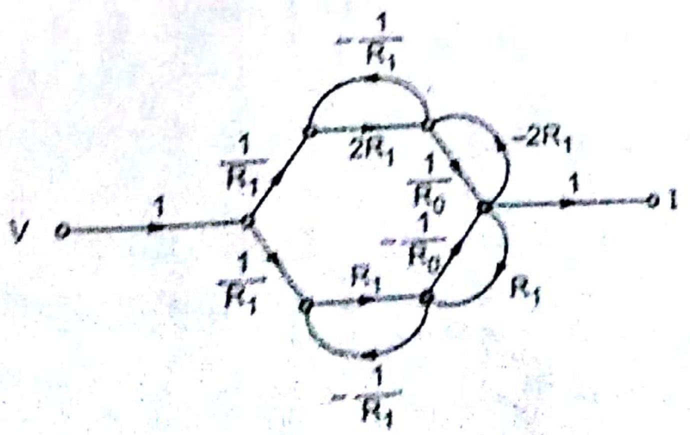


Q. No		Discription of Question	Marks	CO	RBTL
	b	For the given block diagram. [1] Obtain SFG equivalent to the block diagram. [2] Determine the transfer function using Mason's Gain formula.	7	CO315. 1	L4



OR

Q. No		Discription of Question	Marks	CO	RBTL
2	a	Obtain the transfer function of the signal flow graph shown in figure.	6	CO315. 1	L4



	b	Draw the signal flow graph and obtain the transfer function for a system which is described by the set of following algebraic equations.	7	CO315.1

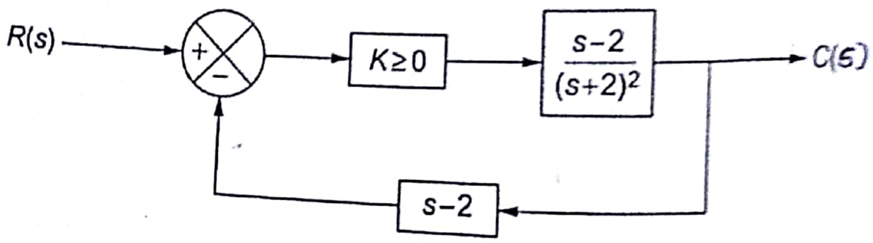
$Y_2 = A_{12}Y_1 + A_{32}Y_3$

$Y_3 = A_{23}Y_2 + A_{43}Y_4$

$Y_4 = A_{24}Y_2 + A_{34}Y_3 + A_{44}Y_4$

$Y_5 = A_{25}Y_2 + A_{45}Y_4$

3	a	The feedback control system is shown in figure below. Find the range of values of '*K*' for the system to be stable.	6	CO315.2	L4



	b	The closed loop transfer function of a position control system is given by	6	CO315.2	L4

$$\frac{C(s)}{R(s)} = \frac{K}{s^4 + 6s^3 + 30s^2 + 60s + K}$$

[1] Determine the range in which K must lie for the syste to be stable.
[2]What should be the upper limit on K if all the closed0loop poles are required to be to the left of the line $\sigma = -1$

OR

4	a	For unity feedback system, system is marginally stable and oscillates with frequency 4 rad/sec. Find K_{mar} & 'q'.	6	CO315.2	L4

$$G(s) = \frac{4}{(s^2 + qs + 2K)\,s}$$

	b	$S^6+4S^5+3S^4-16S^2-64S-48=0$.Find the number of roots of the equation with positive, Zero and negaltive real part.	6	CO315.2	L4

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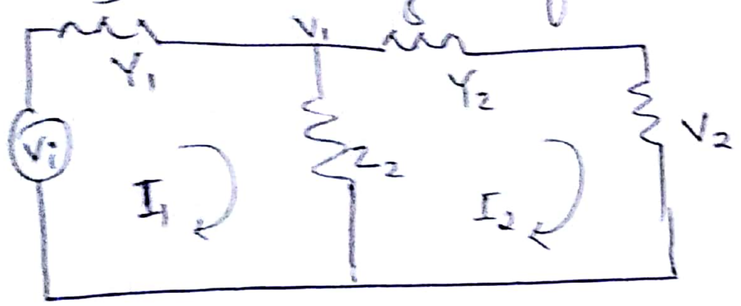
SCHEME OF EVALUATION

Sem: | Subject: | Sub Code: | Date:

Q. No.	BIt	Description	Marks	CO's

Q1 a) Determine the transfer function $\frac{V_2(s)}{V_i(s)}$ using Mason's gain formula.



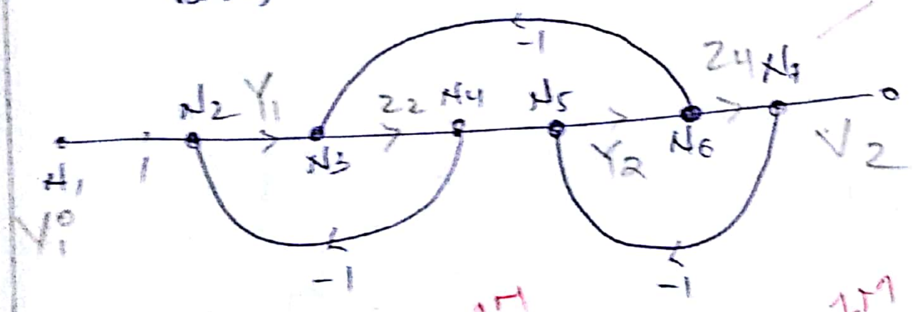
$$i_1(t) = (V_i - V_1) * Y_1$$

$$i_2(t) = (V_1 - V_2) Y_2$$

$$V(t) = [i_1(t) - i_2(t)] Z_2$$

$$V_2(t) = i_2(t) \times Z_4$$

2M



$P_1 = Z_2 Z_4 Y_1 Y_2$ — 1M

$L_1 = -Y_1 Z_2$
$L_2 = -Y_2 Z_2$ — 1M
$L_3 = -Y_2 Z_4$

1M
$L_{21} = Y_1 Y_2 Z_2 Z_4$

$$\Delta = 1 + Y_1 Z_2 + Y_2 Z_2 + Y_2 Z_4 + Y_1 Y_2 Z_1 Z_2$$

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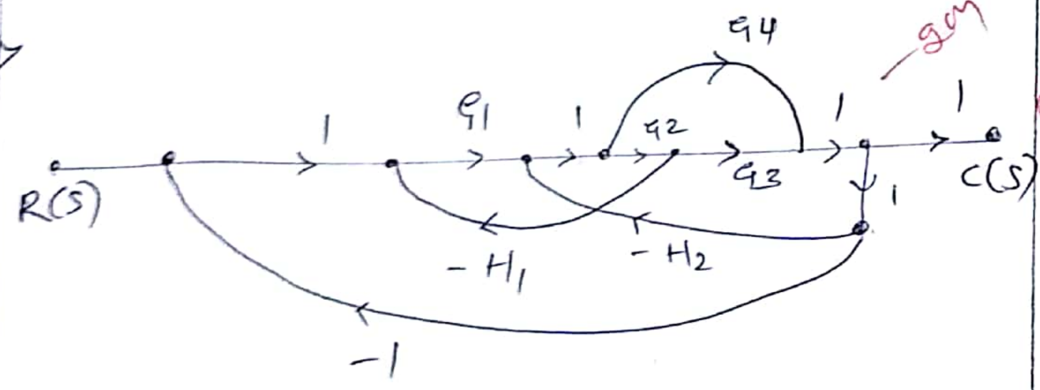
SCHEME OF EVALUATION

Sem :	Subject :	Sub Code :	Date :	Marks	CO's
Q. No. Bit		Description			

$$\frac{V_o(s)}{V_i(s)} = \frac{Y_1 Y_2 Z_2 Z_4}{\Delta} \quad -1M$$

6

Q1 b)



07

$P_1 = G_1 G_2 G_3$
$P_2 = G_1 G_4$ } 1M

$L_1 = -G_2 G_3 H_2$, $L_2 = -G_1 G_2 H_1$ } 1M
$L_3 = -G_1 G_2 G_3$, $L_4 = -G_4 H_2$
$L_5 = -G_1 G_4$ } 1M

$$\Delta = 1 - [L_1 + L_2 + L_3 + L_4 + L_5] + [0] \quad -1M$$

$$\frac{C(s)}{R(s)} = \frac{G_1 G_2 G_3 + G_1 G_4}{1 + G_1 G_2 H_1 + G_2 G_3 H_2 + G_4 H_2 + G_1 G_4 + G_1 G_2 G_3} \quad -1M$$

$\Delta_1 = 1$
$\Delta_2 = 1$

SCHEME OF EVALUATION

Subject : | Sub Code : | Date :

Q. No.	Description	Marks	CO's
2 a)	$T_1 = \frac{2}{R_0}$, $T_2 = \frac{-1}{R_0}$ — 1M		
	$L_1 = -\frac{1}{R_1} \times 2R_1 = -2$ $L_2 = \frac{1}{R_0} \times -2R_1 = \frac{-2R_1}{R_0}$ $L_3 = -\frac{R_1}{R_1} = -1$ $L_4 = -\frac{1}{R_0} \times R_1 = -\frac{R_1}{R_0}$ } 1M	06	
	$L_1L_3 = 2$, $L_1L_4 = \frac{2R_1}{R_0}$ } 1M $L_2L_3 = \frac{2R_1}{R_0}$		
	$\Delta = 1 - [L_1 + L_2 + L_3 + L_4] + (L_1L_3 + L_1L_4 + L_2L_3)$ $= 6 + \frac{7R_1}{R_0}$ — 1M		
	$\Delta_1 = 2$ $\Delta_2 = 3$ } 1M		
	$\frac{I_0(s)}{V_i(s)} = \frac{1}{6R_0 + 7R_1}$ — 1M		

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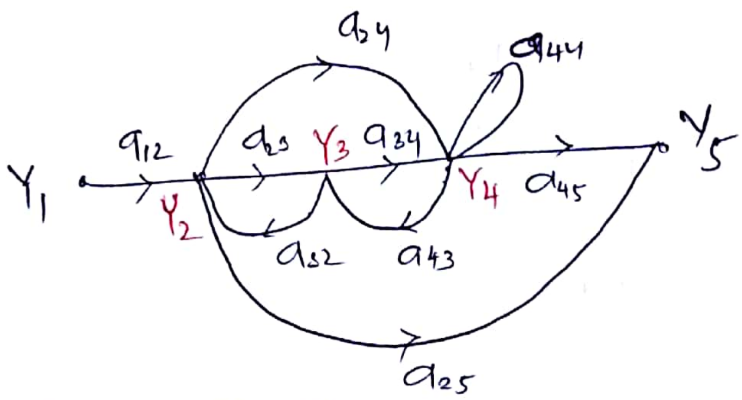
SCHEME OF EVALUATION

Sem :	Subject :	Sub Code :	Date :

Q. No.	Bit	Description	Marks	CO

2 b)



— 9M

$T_1 = a_{12}a_{23}a_{34}a_{45}$

$T_2 = a_{12}a_{24}a_{45}$ } 1M

$T_3 = a_{12}a_{25}$

$L_1 = a_{23}a_{32}$, $L_2 = a_{34}a_{43}$ } 1M

$L_3 = a_{44}$, $L_4 = a_{24}a_{43}a_{32}$

$L_1L_3 = a_{23}a_{32}a_{44}$ — 1M

$\Delta = 1 - [L_1 + L_2 + L_3 + L_4] + [L_1L_3]$ 1M

7

$\Delta_1 = 1$

$\Delta_2 = 1$ } 1M

$\Delta_3 = 1 - (L_2 + L_3)$

$$\frac{Y_5}{Y_1} = \frac{T_1\Delta_1 + T_2\Delta_2 + T_3\Delta_3}{\Delta}$$

Q. No.	Description	Marks	CO's
Q3 (1)	$1 + G(s)H(s) = 0$		
	$1 + \frac{K(s-2)}{(s+2)^2}(s-2) = 0$		
	$(s+2)^2 + K(s-2)^2 = 0$ — 2M	4	
	$(1+K)s^2 + 4(1-K)s + 4K + 4 = 0$		
	s^2 | $1+K$ \ \ $4+4K$		
	s^1 | $4-4K$ \ \ 0 — 2M		
	s^0 | $4+4K$		

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SCHEME OF EVALUATION

Sub Code : Date :

Sem : Subject :

Q. No.	Bit	Description	Marks	CO's
		$4 - 4K = 0$		
		$\frac{4}{4} = K = 1$	2M	$4+2=6$
		$4 + 4K = 0$		
		$4 = -4K$		
		$-1 = K$		
		$-1 < K < 1$		
Q3	b)	$s^4 + 6s^3 + 30s^2 + 60s + K = 0$		
		s^4 : 1, 30, K		
		s^3 : 6, 60		
		s^2 : 20, K	2M	
		s^1 : $\frac{1200 - 6K}{20}$, 0		
		s^0 : K		
		$K > 0$		
		$1200 - 6K > 0$		
		$1200 > 6K \quad \therefore K < 200$	1M	

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SCHEME OF EVALUATION

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Q. No.	Blt	Description	Marks	CO's
		(ii) $s'^4 - 4s'^3 + 6s'^2 - 4s' + 1$ $+ 6s'^3 - 18s'^2 + 18s' - 6$ $+ 30s'^2 - 60s' + 30$ $+ 60s' - 60$ $+ K$ 1M	6	
		$s'^4 + 2s'^3 + 18s'^2 + 14s' - 35 + K = 0$		
		s'^4: 1, 18, $(-35+K)$		
		s'^3: 2, 14		
		s'^2: 11, $-35+K$ 2M		
		s'^1: $\frac{224-2K}{11}$		
		s'^0: $-35+K$		
		$K < 112$		
Q4 a)		$a = \frac{2}{4K}$ 2M	6	
		$s = \pm j \frac{2}{\sqrt{a}}$ 1M		
		comparing $s = \pm j\omega$ ∵ freq = 4		
		$4 = \frac{2}{\sqrt{a}}$ 1M		
		$a = 0.25$ 1M & $K = 8$ 1M		

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SCHEME OF EVALUATION

Sem : | Subject : | Sub Code : | Date :

Q. No.	Bit	Description	Marks	CO
Q4	b)			

s^6	1	3	-16	-48
s^5	4	0	-64	0
s^4	3	0	-48	0
s^3	6	0	0	

case 2

$A(s) = 3s^4 - 48 = 0$, $\frac{dA}{ds} = 12s^3$

— 00 —

s^3	12	0	0
s^2	ε[0]	-48	
s^1	$\frac{576}{\varepsilon}$	0	
s^0	-48		

case 1

$\frac{576}{\varepsilon} = +\infty$

$s^2 = y$ ∴ $y = 16$

$3y^2 = 48$ $s^2 = -4$

$s = \pm 2$, $s = \pm 2j$

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EvenSem(2017-18)

THIRD INTERNAL ASSESSMENT

Sem :VI
Date: 18/05/2018

Sub: CONTROL SYSTEM
Time: 11AM-12NOON

Sub. Code: 15EE61
Max. Marks: 25

Note: Answer two full questions, draw sketches wherever necessary.

Q. No		Discription of Question	Marks	CO	RBTL
1	a	Sketch the root locus for the system having $G(s)H(s) = \frac{K(s+5)}{(s^2+4s+20)}$	6	CO315. 4	L4
	b	Sketch the root locus for the system having $G(s)H(s) = \frac{K(s+0.5)}{s(s^2+2s+2)}$ Also determine 'K' for damping ratio of 0.5 from the root locus.	7	CO315. 4	L4
		OR			
2	a	Sketch the root locus for the system having $G(s)H(s) = \frac{K(s+1)}{s(s-1)(s^2+5s+20)}$ Comment on stability.	9	CO315. 4	L4
	b	Consider the system with $G(s)H(s)=\frac{K}{s(s+2)(s+4)}$, find whether s= -0.75 and s= -1+j4 ison the root locus or not using angle condition.	4	CO315. 4	L4
3	a	A unity feedback system $G(s)=\frac{800(s+2)}{s^2(s+10)(s+40)}$ Sketch the bode plot, comment on stabilty.	6	CO315. 4	L4
	b	A unity feedback system $G(s)=\frac{K}{s(s+4)(s+10)}$ Determine marginal value of 'K'for which system is marginally	6	CO315. 4	L4
		OR			
4	a	A System has $G(s)H(s) = \frac{K(s+2)}{s(s+4)(s+10)}$. Find K to get PM = +30°.	6	CO315. 4	L4
	b	For a particular unity feedback system, $G(s) = \frac{242(s+5)}{s(s+1)(s^2+5s+121)}$ Sketch the Bode plot. Find GM, PM, ωgc & ωpc. Comment on stability.	6	CO315. 4	L4

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IA Scheme
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3rd - IA SCHEME OF EVALUATION

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Sem :	Subject :		Sub Code :	Date :	
Q. No.	Bit	Description		Marks	Mapped CO's
Q1	a)	$G(s)H(s) = \frac{K(s+5)}{(s^2+4s+20)}$ $P=2, Z=1, N=P, P:s=-2\pm j4$ $\theta_1 = 180$ — (1M) No centroid Breakaway point $s^2+(4s+Ks)+(20+5K)=0$ $\frac{dK}{ds} = \frac{vu'-uv'}{v^2} = 0$ $-s^2-10s=0$ $-s(s+10)=0$ — (01M) $s=-10, \quad K=+16$ Intersection with img axis s^2 | 1 $20+5K$ s^1 | $K+4$ 0 — (1M) s^0 | $20+5K$ $K_{mar} = -4$ — (01M) — (01M) graph (01M) $\phi_d = +143.3$ at $-2+j4$		6M	
Q1	b)	$G(s)H(s) = \frac{K(s+0.5)}{s(s^2+2s+2)}$ $P=3, Z=1, N=P=3$ $\theta_1 = 90$ $P-Z = 2 = q$ $\theta_2 = 270$ $q = 0 \text{ \& } 1$ — (1)			

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- IASCHEME OF EVALUATION

Sem :		Subject :	Sub Code :	Date :	
Q. No.	Bit	Description		Marks	Mapped CO's
		Centroid, $\sigma = -0.75$. — (1M)			
		No Breakaway point			
		$s^3 + 2s^2 + 2s + Ks + 0.5K = 0$			
		s^3 | 1 $K+2$			
		s^2 | 2 $0.5K$		7	
		s^1 | $\frac{1.5K+4}{2}$ 0			
		s^0 | $0.5K$ (1M)			
		$K_{mar} = -2.67$ so No intersection in img axis			
		$\phi d = 71.56$ (1M) at $-1+j$			
		$\xi = 0.5$ (1M) (1M) (1M)			
		$s = -0.88 + 1.4j$ from the graph			
		$K = 0.73$ for $\xi = 0.5$			
Q2	a	$G(s)H(s) = \frac{K(s+1)}{s(s-1)(s^2+5s+20)}$			
		$P=4, Z=1, N=P=4, P-Z=3=2$			
		$\theta_1 = 60, \theta_2 = 180, \theta_3 = 300$ — (1M)			
		$\sigma = -1$ — (1M)			
		Breakaway point:			
		$K = \frac{-s^4 - 4s^3 - 15s^2 + 20s}{(s+1)}$ — (1M)			

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- IASCHEME OF EVALUATION

Sem : | Subject : | Sub Code : | Date :

Q. No.	Bit	Description	Marks	Mapped CO's
		$s^4 + 4s^3 + 9s^2 + 10s - 6.667 = 0$ (1M)		
		synthetic div method		
		$s = 0.44$, $s = -2.45$		
		$K = +ve$ $K = +ve$		
		Intersection with img axis		
		$s^4 + 4s^3 + 15s^2 + s(K-20) + K = 0$		
		$K = 80$, (1M)		
		$K = 54.8 ; 29.19$ (1M)	9M	
		$s^2 = -8.69$; $s = \pm j1.515$		
		$s = \pm j2.94$; (1M)		
		$\phi_d = -52.75$ or 55 (1) graph (1M)		
2	b)	$s = -0.75$ & $s = -1+j4$		
		$G(s)H(s) = \frac{K}{s(s+2)(s+4)}$		
		$s = -0.75$; $\angle G(s)H(s) = -180°$ (2M)	4M	
		$s = -1+j4$; $\angle G(s)H(s) = -233.1$ (2M)		
3	b)	$G(s)H(s) = \frac{K(s+2)}{s(s+4)(s+10)}$		
		$= \frac{K(1+\frac{s}{2})}{s(1+\frac{s}{4})(1+\frac{s}{10})}$		
		i) K is unknown		

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- IASCHEME OF EVALUATION

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Sem :		Subject :	Sub Code :	Date :
Q. No.	**Bit**	**Description**	**Marks**	
		$1/s$, 1 pole at origin (3M)		
		simple zero, $\left(1+\frac{s}{2}\right)$, $T_1 = \frac{1}{2}$, $\omega_{c_1} = 2$		
		simple pole, $\frac{1}{1+s/4}$, $T_2 = \frac{1}{4}$, $\omega_{c_2} = 4$		
		simple pole, $\frac{1}{1+s/10}$, $T_3 = 1/10$, $\omega_{c_3} = 10$ (6M)		
		$\phi = 0 + \tan^{-1}\frac{\omega}{2} - 90 - \tan^{-1}\frac{\omega}{4} - \tan^{-1}\frac{\omega}{10}$ (2M)		
		$P.M = 30^\circ$		
		$PM = 180^\circ + \angle G(j\omega)H(j\omega)\Big\vert_{\omega=\omega_{gc}}$		
		$30 - 180 = \angle G(j\omega)H(j\omega)\Big\vert_{\omega=\omega_{gc}}$		
		$\omega_{gc} = -150^\circ$		
		$20\log K = +29$ (graph 1M)		
		$K = 563.6$ to get $P.M = 30^\circ$		
3	a)	$G(s)H(s) = \frac{800(s+2)}{s^2(s+10)(s+40)}$		
		$= \frac{4\left(1+\frac{s}{2}\right)}{s^2\left(1+\frac{s}{10}\right)\left(1+\frac{s}{40}\right)}$		
		i) $K = 4$		
		ii) 2 poles at the origin		

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SUBJECT: | SUBJECT CODE: | DATE:

Q.No.	Bits	DESCRIPTION	Marks	CO's
		iii) Simple zero, $T_1 = \frac{1}{2}$, $\omega_{c1} = 2$ rad/sec	3M	
		iv) Simple pole, $T_2 = \frac{1}{10}$, $\omega_{c2} = 10$ rad/sec	6M	
		v) Simple pole, $T_3 = \frac{1}{40}$, $\omega_{c3} = 40$ rad/sec		
		Phase angle plot		
		$\phi = 0 - 180 + \tan^{-1}\frac{\omega}{2} - \tan^{-1}\frac{\omega}{10} - \tan^{-1}\frac{\omega}{40}$		
		From graph $\omega_{pc} = 18$, $\omega_{gc} = 2$	2M	
		GM = 24 dB, PM = 31°	1M	
Q3	b)	$K = K'$		
		$G(s) = \frac{K}{s(s+4)(s+10)}$		
		$= \frac{0.025K}{s\left(\frac{s}{4}+1\right)\left(\frac{s}{10}+1\right)}$	3M	
		① $K' = 0.025K$		
		② $\frac{1}{s}$, 1 pole at the origin		
		③ $1 + \frac{s}{4}$, simple pole, $T_1 = \frac{1}{4}$; $\omega_{c1} = 0.25$ rad/sec		
		④ simple pole, $T_2 = \frac{1}{10}$, $\omega_{c2} = 0.1$ rad/sec		

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SCHEME OF EVALUATION IA -

Page No. DATE:

SEM:		SUBJECT:	SUBJECT CODE:
Q.No.	Bits	DESCRIPTION	Marks
		$\phi = 0 - 90 - \tan^{-1}(0.1\omega) - \tan^{-1}(0.25\omega)$	3M
Q4	a)	$G(s) = \frac{K(s+2)}{s(s+4)(s+10)}$	
		standard form	
		$\frac{\frac{K}{20}\left(1+\frac{s}{2}\right)}{s\left(1+\frac{s}{4}\right)\left(1+\frac{s}{10}\right)}$ let $\frac{K}{20} = K'$	6M
		(1) 'K' is unknown	
		(2) $1/s$, 1 pole at the origin	3M
		(3) simple zero, $T_1 = 1/2$, $\omega_{c_1} = 2$ rad/sec	
		(4) simple pole, $T_2 = 1/4$, $\omega_{c_2} = 4$ rad/sec	
		(5) simple pole, $T_3 = \frac{1}{10}$, $\omega_{c_3} = 10$ rad/sec	
		$\phi = 0 - 90 + \tan^{-1}\left(\frac{\omega}{2}\right) - \tan^{-1}\left(\frac{\omega}{4}\right) - \tan^{-1}\left(\frac{\omega}{10}\right)$	3M
	b)	$G(s) = \frac{242(s+5)}{s(s+1)(s^2+5s+121)}$	

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