Subject Code: XXXXX
Roll No:

BTECH
(SEM-5) CONTROL SYSTEM 2021-22

TIME:3 HOUR ***Total Marks: 100***

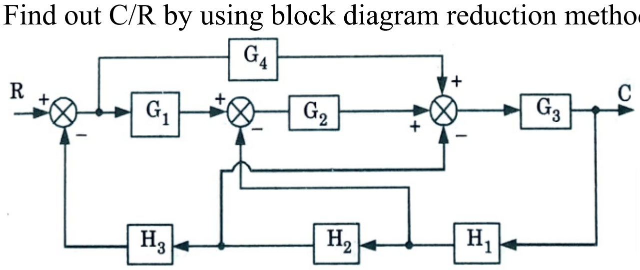
Instruction: Attempt the questions as per the given instructions. Assume missing data suitably.

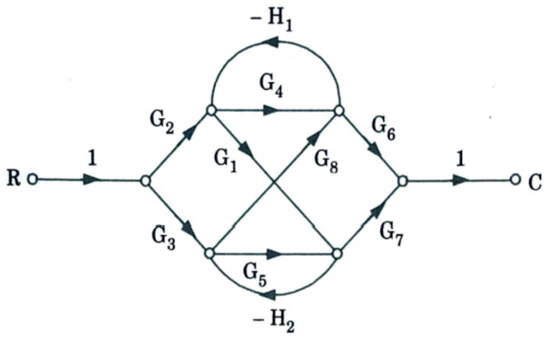
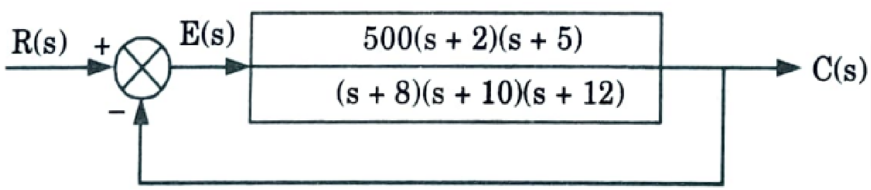
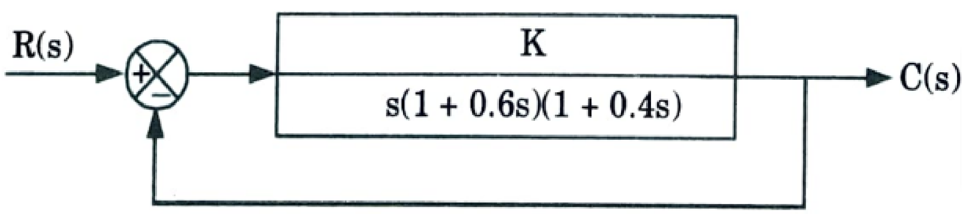
SECTION - A

Attempt *All Parts* in Brief **2*10 = 20**

Q1	**Questions**	**Marks**
(a)	Draw the block diagram, which represent a driver driving a car.	2
(b)	Define: Self loop and non-touching loop in signal flow graph by suitable example.	2
(c)	What do you mean by settling time, write expression for 2nd order system?	2
(d)	The OLTF of a unity feedback system is G(s) = 1/s(s + 1)(s+4) find the steady state error (e_{ss}) due to a unit step.	2
(e)	What are the limitations of Routh Hurwitz criterion ?	2
(f)	State absolute stability and relative stability.	2
(g)	Draw the polar plot G(s) = 1/(s +2)	2
(h)	Write advantages of Bode Plot.	2
(i)	Find the eigen vectors of the matrix $A = \begin{bmatrix} -3 & 1 \\ 1 & -3 \end{bmatrix}$	2
(j)	Why compensators are used in control system, what is effect of lag compensator ?	2

SECTION - B		
Attempt *Any Three* of the following		**3*10 = 30**
Q2	**Questions**	**Marks**
(a)	Write down various rules involve in block diagram reduction method.	10
(b)	The unity feedback system is characterized by an open loop transfer function is G(S) = K/s(s + 20). Determine the gain K, so that the system will have a damping ratio of 0.6. For this value of K, determine unit step response, time domain specifications: settling time (2% criterion), peak overshoot, rise time, peak time, delay time for a unit-step input.	10
(c)	Explain the effect of addition of pole and zero on root locus and time domain specifications.	10
(d)	Sketch the polar plot of the following function, also determine gain margin, phase margin, H(s) = 1 $$G(s) = \frac{1}{s(1+s)(1+2s)}$$	10
(e)	State properties of State Transition Matrix (STM), find out state transition matrix for $$A = \begin{bmatrix} 0 & 1 \\ -8 & -6 \end{bmatrix}$$	10

SECTION - C		
Attempt *Any One* of the following		**5*10 = 50**
Q3	**Questions**	**Marks**
(a)	Find out C/R by using block diagram reduction method. 	10
(b)	Find the overall gain of the system whose signal flow graph is shown below.	10

		
Q4	**Questions**	**Marks**
(a)	Compare proportional (P) control action with integral (I) control action and prove that by using proportional integral PI controller steady state error become zero in a system.	10
(b)	Find out various error coefficients : K_p, K_v, K_a and steady state error for standard step, ramp, and parabolic inputs for system shown below : 	10
Q5	**Questions**	**Marks**
(a)	Explain the effect of pole location on stability of a system by suitable diagram, determine range of Kand frequency of sustained oscillations for a given unity feedback system. 	10
(b)	Sketch the root locus of the system whose open loop transfer function is G(S)=K/s(s +2)(s + 5). Find the value of K so that system is marginal stable find out damped frequency of oscillation, also find K when the damping ratio of the closed loop system is 0.5.	10
Q6	**Questions**	**Marks**
(a)	Sketch Bode plot for the following transfer function and determine the gain cross over frequency and phase cross over frequency, comment on stability. G(s) H(s)= 10/s (1 + s)(1 + 0.002s)	10
(b)	Draw the complete Nyquist plot for a unity feedback system having the open loop function; from this plot obtain all the information regarding stability. G(s) H(s) = k/s(s + 3)(s + 5)	10

Q7	Questions	Marks
(a)	Design a lead compensator for a system whose open loop transfer function is G(s)H(s) = 4s(s + 2) It will fulfill following requirement i. Static velocity error constant = 20 sec^{-1} ii. PM at least 50° iii GM at least 10 db	10
(b)	Determine the state controllability and observability of the system described $\dot{x} = \begin{bmatrix} 0 & 1 & 1 \\ 0 & 0 & 3 \\ -7 & 5 & 9 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix} u$ and Y = [5 2 7]x	10