Hall Ticket Number:

Code No. : 16448 AS

VASAVI COLLEGE OF ENGINEERING *(AUTONOMOUS)*, HYDERABAD

Accredited by NAAC with A++ Grade

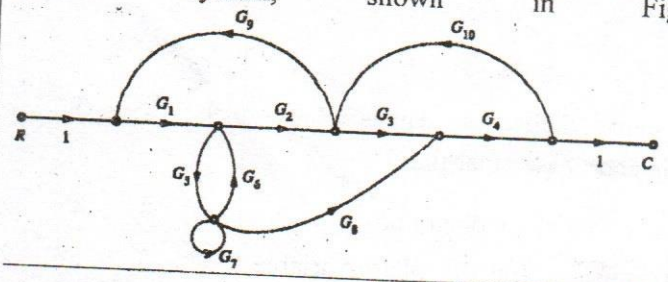
B.E. (E.C.E.) VI-Semester Advanced Supplementary Examinations, July-2023

Control Systems Engineering

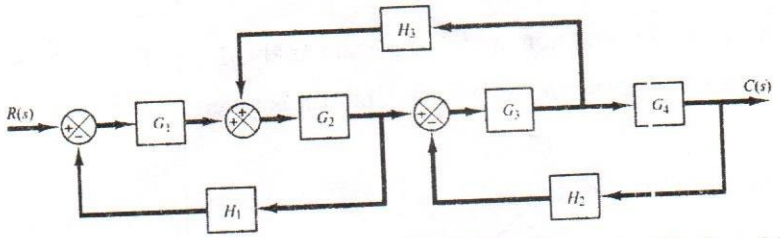
Time: **3 hours** Max. Marks: **60**

*Note: Answer all questions from **Part-A** and any **FIVE** from **Part-B***

Part-A (10× 2 = 20 Marks)

Q. No.	Stem of the question	M	L	CO	PO	PSO
1.	Classify the control systems in all respects.	2	1	1	1	1
2.	Illustrate how a branch point is moved after a summing point in a block diagram of a system.	2	1	1	1	1
3.	Evaluate the time constant of a control system whose closed loop transfer function is given as $G(s) = \frac{K}{s(s+0.5)(s+2)}$.	2	2	2	2	-
4.	What is the need of break away and break in points in the Root Locus method of stability?	2	1	2	1	-
5.	How are the Gain & Phase Margins important in analyzing the Stability of a Control System?	2	1	3	2	1
6.	State the principle of argument in determining Nyquist stability.	2	1	3	1	1
7.	Differentiate compensator and controller.	2	1	4	1	1
8.	Draw the block diagram of PID controller neatly.	2	1	4	1	1
9.	List any two limitations with transfer function model of system analysis.	2	1	5	1	-
10.	Obtain state transition matrix for the state model whose A matrix is given by $A = \begin{bmatrix} 0 & 1 \\ -1 & -2 \end{bmatrix}$	2	2	5	2	-
	Part-B (5×8 = 40 Marks)					
11.a)	List advantages and disadvantages of a closed loop control system, in comparison with open loop system.	4	2	1	2	1
b)	Using Mason's gain formulae find C/R of the Signal Flow Graph of a control system, shown in Figure below. 	4	3	1	3	1
12. a)	Consider unity feedback control system with open loop transfer function $G(s) = \frac{20}{s(s+1)}$. Determine rise time, peak lovershoot, peak time and settling time.	4	2	2	1	-
b)	Sketch the root locus for the system described by the fo lowing transfer function, $G(s)H(s) = \frac{K}{S(S+2)(S+4)}$. Also determine the range of d.c. gain for which the system Is stable.	4	3	2	2	-

Contd ... 2

13. a)	A unit step response test conducted on a second order system yielded peak overshoot 0.2 and peak time 0.3ms. Obtain corresponding resonant peak and resonant frequency.	2	2	3	2	1
b)	Analyze the stability of the system with the following transfer function using Bode plot technique and determine gain crossover frequency, phase crossover frequency, gain margin and phase margin. $$G(S)H(S) = \frac{80(S+5)}{S^2(S+50)}$$	6	4	3	4	1
14. a)	A control system is described by the open loop transfer function of $G(s) = \frac{20}{s(s+1)(s+4)}$. Design an appropriate compensator for the specifications of maximum peak overshoot as 20% and the settling time is 4seconds.	6	3	4	3	1
b)	Write the advantages and disadvantages of PD controller.	2	2	4	2	1
15. a)	State and prove the properties of state transition matrix.	4	2	5	2	-
b)	A MIMO system is described by the following State space model. Analyse the system for controllability and observability. $$\dot{x} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix} x + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u;\ y = [4 \quad 5 \quad 1]\, x$$	4	4	5	4	-
16. a)	Simplify the block diagram shown in Figure. Then obtain the closed-loop transfer function $G(s) = \frac{C(s)}{R(s)}$. 	4	2	1	1	1
b)	The open loop transfer function of a closed loop system with closed loop system with unity feedback is $G(s) = \frac{K}{(s+2)(s+4)(s^2+6s+25)}$. Apply Routh criterion, to determine the value of K for sustained oscillations.	4	3	2	1	-
17.	Answer any ***two*** of the following:					
a)	The open loop transfer function of a unity feedback system is $G(s) = \frac{1}{S(1+S)(1+2S)}$. Determine the Gain margin and Phase margin.	4	3	3	2	1
b)	Explain the features of PI controller with a neat block diagram.	4	3	4	2	1
c)	Find the state equations and output equation for the phase-variable representation of the transfer function $\mathbf{Y(s)} = \frac{24}{s^3+9s^2+26s+24}$.	4	3	5	2	-

M : Marks; L: Bloom's Taxonomy Level; CO; Course Outcome; PO: Programme Outcome

i)	Blooms Taxonomy Level – 1	20%
ii)	Blooms Taxonomy Level – 2	30%
iii)	Blooms Taxonomy Level – 3 & 4	50%

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