Hall Ticket Number:

Code No. : 16339 AS

VASAVI COLLEGE OF ENGINEERING *(AUTONOMOUS)*, HYDERABAD

Accredited by NAAC with A++ Grade

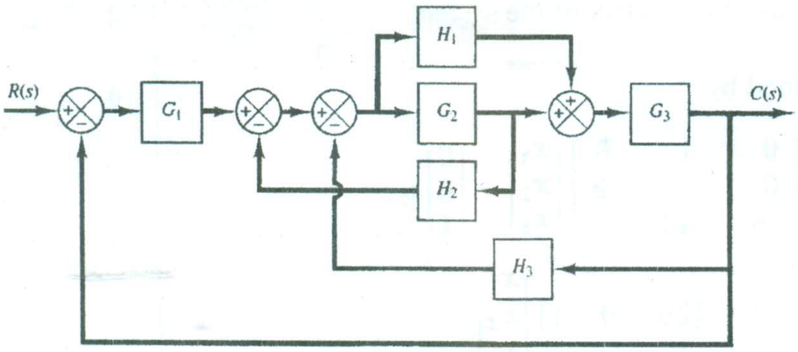
B.E. (E.E.E.) VI-Semester Advanced Supplementary Examinations, August-2022

Control Systems

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
1.	Compare the negative feedback system and positive feedback system.	2	1	1	1,2
2.	Define the following terms with suitable examples; i) System, ii) Control System, iii) Open loop system, iv) Closed loop system.	2	1	1	1,2
3.	Define rise time, settling time, maximum overshoot and peak time of the system.	2	1	2	1,2
4.	Consider a system $G(s) = \frac{(S+20)}{S^2(S^2+9S+24)}$ with unit feedback. Calculate the error constants (K_p, K_v, K_a) and the system type.	2	2	2	1,2
5.	Define the resonant peak of the system.	2	1	3	1,2
6.	Explain the concept of relative stability analysis of the system.	2	2	3	1,2
7.	Compare Bode plot and Nyquist plot based system analysis.	2	1	4	1,2
8.	State the principle of argument.	2	1	4	1,2
9.	Compare the state space approach and the transfer function approach.	2	2	5	1,2
10.	Write any two properties of state transition matrix.	2	2	5	1,2
	Part-B (5×8 = 40 Marks)				
11. a)	Compare the merits & demerits of Block diagram reduction technique and Signal Flow Graph approach	4	2	1	1,2
b)	Find the closed loop transfer function $\frac{C(s)}{R(s)}$ of the diagram shown below using the block diagram reduction technique 	4	3	1	1,2

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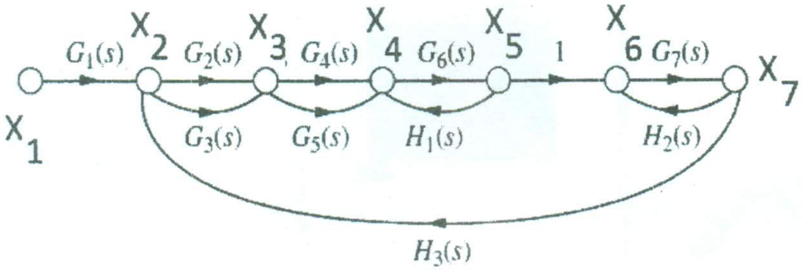
12. a)	Consider the following characteristic equation $$s^4 + 2s^3 + (4+K)s^2 + 9s + 25 = 0$$ Determine the range of K for stability using the Routh-Hurwitz stability criterion.	3	3	2	1,2
b)	Draw the rough sketch of the root locus (with the detailed steps) of open loop transfer function given as $$G(s)H(s) = \frac{K}{s(s+1)(s^2+4s+5)}\ ; H(s) = 1$$ Also find out the imaginary axis crossing point and indicate it in the rough sketch.	5	3	2	1,2
13. a)	Compare the frequency response and time response of a system. Define Bandwidth of the system.	4	2	3	1,2
b)	Draw the Bode diagram (asymptotic magnitude plot and Phase plot) for the following transfer function with the detailed steps $$G(s) = \frac{2500\,(s+11)}{s(s+3)(s^2+30s+2500)}$$	4	3	3	1,2
14. a)	State the Nyquist stability criterion.	4	2	4	1,2
b)	Consider a unity-feedback control system with the following open-loop transfer function $$G(s) = \frac{K}{s(s+1)(s+2)}$$ Draw a Nyquist (rough) plot of *G(s)* with the detailed steps	4	3	4	1,2
15. a)	Define a state and state transition matrix of the system.	4	2	5	1,2
b)	Consider the system defined by $$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\\ \dot{x}_3\end{bmatrix} = \begin{bmatrix}0 & 1 & 0\\ 0 & 0 & 1\\ -6 & -11 & -6\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix} + \begin{bmatrix}0\\ 0\\ 1\end{bmatrix}u\ ;$$ $$y = \begin{bmatrix}20 & 9 & 1\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix}$$ Is the system completely controllable and completely observable?	4	3	5	1,2

Contd... 3

		M	L	CO	PO
16. a)	For the Control System described by a Signal Flow Graph shown in below Figure, illustrate all the steps of Mason's Gain Formula and hence, determine the transfer function $\frac{X_7(s)}{X_1(s)}$.	4	3	1	1,2



		M	L	CO	PO
b)	Determine the values of damping factor, natural undamped frequency, damping frequency, percentage overshoot, peak time, rise time and settling time. $$M(s) = \frac{49}{s^2 + 4s + 49}$$	4	3	2	1,2
17.	Answer any ***two*** of the following:				
a)	Define Gain margin and phase margin. Compare the Lead compensator and Lag compensator.	4	1	3	1,2
b)	Sketch the polar plot of the following transfer functions a) $G(s) = \frac{1}{(1+sT_1)(1+sT_2)}$ b) $G(s) = \frac{1}{s^2(1+sT_1)(1+sT_2)}$	4	3	4	1,2
c)	Consider the following matrix A $$\mathbf{A} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix}$$ Compute e^{At}.	4	3	5	1,2

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

i)	Blooms Taxonomy Level – 1	21%
ii)	Blooms Taxonomy Level – 2	31.5%
iii)	Blooms Taxonomy Level – 3 & 4	47.5%

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