Hall Ticket Number:

Code No. : 16441 N

VASAVI COLLEGE OF ENGINEERING *(AUTONOMOUS)*, HYDERABAD

Accredited by NAAC with A++ Grade

B.E. (E.C.E.) VI-Semester Main Examinations, May/June-2023

Control Systems Engineering

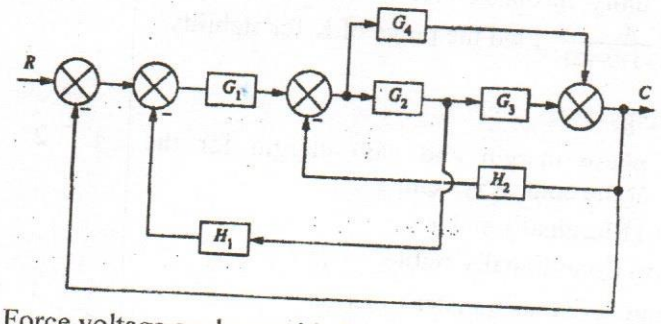
Time: **3 hours** Max. Marks: **60**

*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.	What is effect of negative feedback on stability of a system?	2	1	1	1	1
2.	Write the force balance equation of an ideal mass, dashpot and spring element.	2	1	1	1	1
3.	Given a unity feedback control system with $G(s) = \frac{K}{S(S+1)}$. Estimate the steady state error due to step input.	2	3	2	2	-
4.	Find Transfer Function of a system whose unit step response is a unit impulse function.	2	3	2	1	-
5.	Define Gain Margin and Phase Margin.	2	1	3	1	1
6.	Calculate Phase cross over frequency for a unity feedback control system with $G(s) = \frac{10}{S(S+1)}$	2	3	3	2	1
7.	What is the effect of PI controller on a control system?	2	1	4	1	1
8.	Draw pole zero plot of lead compensator and lag compensator.	2	1	4	1	1
9.	Write the properties of state transition matrix	2	1	5	1	-
10.	Explain the concept of state.	2	2	5	1	-

Part-B (5×8 = 40 Marks)

11. a)	Derive the transfer function of the system shown below using block diagram reduction rules. 	4	2	1	2	1
b)	Compare Force voltage analogy with force current analogy.	4	2	1	1	1
12. a)	A unity feedback control system has an open loop transfer function $G(s) = \frac{10}{S(S+2)}$ Find the rise time, percentage over shoot, peak time and settling time.	4	3	2	2	-
b)	Determine the stability of system represented by characteristic equation $s^6 + 3s^5 + 4s^4 + 6s^3 + 5s^2 + 3s + 2 = 0$ Comment on the location of roots.	4	2	2	2	-

Contd... 2

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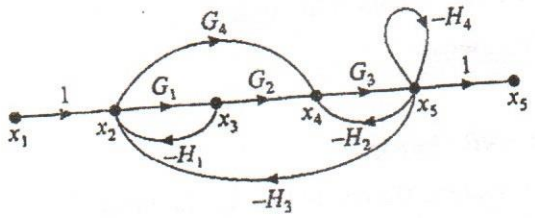
13. a)	A unit step response test conducted on a second order system yielded peak overshoot Mp = 0.12 and peak time tp = 0.2s. Obtain resonant peak and resonant frequency	4	3	3	2	1
b)	The open loop transfer function of a unity feedback control system is given $G(s) = \frac{10}{S(1+0.1S)(1+S)}$. Draw the bode plot and find Gain Margin and Phase margin	4	4	3	2	1
14. a)	Design suitable lead compensator for a system with unity feedback and having open loop transfer function $G(s) = \frac{K}{S(S+1)(S+4)}$ to meet the specifications.(i)Damping ratio=0.5 (ii) Un-damped natural frequency = 2 rad/sec	6	4	4	3	1
b)	What type of controller you choose to reduce steady state error without effecting stability of system. Justify your answer.	2	4	4	1	1
15. a)	Obtain the transfer function of the system described by $\begin{bmatrix}\dot{x_1}\\ \dot{x_2}\end{bmatrix} = \begin{bmatrix}0 & 1\\ -2 & -3\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix} + \begin{bmatrix}0\\ 1\end{bmatrix}u$; $x(0) = \begin{bmatrix}1\\ 1\end{bmatrix}$; $y = [1 \quad 0]\begin{bmatrix}x_1\\ x_2\end{bmatrix}$	4	3	5	2	-
b)	The state space representation of a system is given below $\dot{x} = \begin{bmatrix}-2 & 1 & 0\\ 0 & -3 & 1\\ -3 & -4 & -5\end{bmatrix}x + \begin{bmatrix}0\\ 0\\ 1\end{bmatrix}u$; $y = [0 \quad 1 \quad 01]\,x$ Determine Controllability and Observability.	4	2	5	2	-
16. a)	Using Mason's gain formulae find $\frac{x_5}{x_1}$ of the SFG shown in Figure below. 	4	2	1	2	1
b)	Sketch the root locus of the unity feedback system whose open loop transfer function $G(s) = \frac{K}{S(S+1)(S+2)}$. Find the range of K for stability.	4	3	2	2	-
17.	Answer any ***two*** of the following:	4	2	4	1	1
a)	Comment on the range of phase margin and gain margin for the following stability conditions of the control system. (i) Unstable (ii) Marginally stable (iii) Absolutely stable (iv) Conditionally stable.	4	1	3	1	1
b)	Draw lag-lead compensator and derive its transfer function	4	3	5	2	-
c)	A LTI System is characterized by homogeneous state equation $\begin{bmatrix}\dot{x_1}\\ \dot{x_2}\end{bmatrix} = \begin{bmatrix}1 & 0\\ 1 & 1\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}$ Compute the solution of state equation. Assume the initial state vector: ; $x(0) = \begin{bmatrix}1\\ 0\end{bmatrix}$.					

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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