Hall Ticket Number:

Code No. : 15359 N/O

VASAVI COLLEGE OF ENGINEERING *(AUTONOMOUS)*, HYDERABAD

Accredited by NAAC with A++ Grade

B.E. (E.E.E.) V-Semester Main & Backlog Examinations, Jan./Feb.-2024

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.	A unity feedback control system has an impulse response of $c(t) = e^{-2t}u(t)$ then determine the open loop transfer function.	2	2	1	1,2,12
2.	List the various components of control systems.	2	1	1	1,2,12
3.	The open loop transfer function of a unity feedback control system is $G(s) = \frac{10(s+2)}{s^2(s+1)}$. Determine i)Type of system ii) Static error constants	2	1	2	1,2,12
4.	A servo system has a periodic oscillation time of 0.4 seconds and its first overshoot is 25%. Determine the settling time if the allowable tolerance limits are ±5%.	2	2	2	1,2,12
5.	Define the terms i) Resonant peak ii) Resonant frequency for the second order system.	2	1	3	1,2,12
6.	Draw the approximate bode plot for a finite pole on the negative real axis i.e.,$G(s) = \frac{1}{1+s\tau}$	2	1	3	1,2,12
7.	State the principle of argument in Nyquist stability criterion.	2	1	4	1,2,12
8.	What are the advantages of frequency response analysis?	2	1	4	1,2,12
9.	Mention the properties of state transition matrix	2	1	5	1,2,12
10.	Enumerate the differences between state space approach over transfer function model.	2	1	5	1,2,12
	Part-B (5×8 = 40 Marks)				
11. a)	Distinguish between open loop & closed loop control systems with examples.	4	2	1	1,2,12
b)	Draw the electrical analogous circuits for the mechanical translational system shown in Fig.1	4	3	1	1,2,12

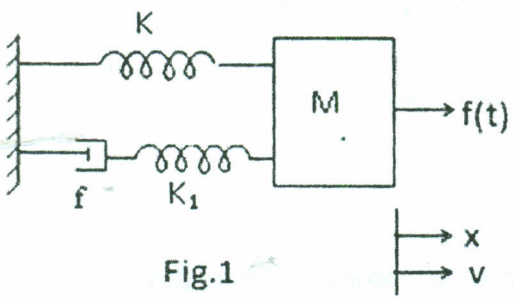

Fig.1

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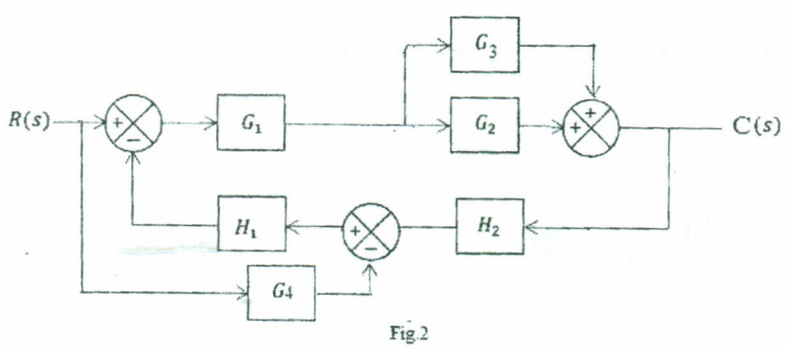
12. a)	By using R-H criteria , Determine the location of roots on the s-plane and hence the stability for the system represented by the characteristic equation $s^5 + 4s^4 + 8s^3 + 8s^2 + 7s + 4 = 0$	4	4	2	1,2,12
b)	Determine the Centroid & Angle of departure/arrival for the open loop transfer function $G(s) = \frac{k(s+9)}{s(s^2+4s+11)}$ in the root locus method.	4	3	2	1,2,12
13. a)	Describe the necessity of lead compensator and also draw its frequency response	4	2	3	1,2,12
b)	Find the gain crossover frequency & phase margin for the open loop transfer function $G(s) = \frac{2\sqrt{3}}{s(s+1)}$.	4	3	3	1,2,12
14. a)	Illustrate the procedure to determine the gain & phase margin from polar plot with a neat sketch.	3	2	4	1,2,12
b)	Sketch the Nyquist plot for the function $G(s)H(s) = \frac{1}{s(s+1)}$	5	3	4	1,2,12
15. a)	Construct state model matrix for the given transfer function $\frac{Y(s)}{U(s)} = \frac{10(s+4)}{s(s+1)(s+3)}$, Where Y(s) & U(s) are Output & Input respectively	4	3	5	1,2,12
b)	A single input and single output linear time invariant system is described by the following matrices $A = \begin{bmatrix} -5 & 1 & 0 \\ 0 & -2 & 1 \\ 20 & -10 & 1 \end{bmatrix}$; $B = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$; $C = [-1 \quad 1 \quad 0]$. Check the Controllability and Observability of the above matrices.	4	2	5	1,2,12
16. a)	Draw the signal flow graph to evaluate the closed loop transfer function of a system whose block diagram is shown in Fig.2  Fig.2	5	4	1	1,2,12
b)	Discuss the effect on the performance of a second order control system with PID controller	3	2	2	1,2,12

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17.	Answer any ***two*** of the following:				
a)	Develop the transfer function for the asymptotic Bode magnitude plot of a minimum phase system G(s) shown in Fig.3	4	3	3	1,2,12
b)	Sketch the polar plot for the function $G(s) = \frac{10}{(s+1)(s+2)}$ and also find the intersection point with negative imaginary axis.	4	3	4	1,2,12
c)	Write a short notes on the following terms i) State ii) State variables iii) State Model in the state space representation.	4	2	5	1,2,12

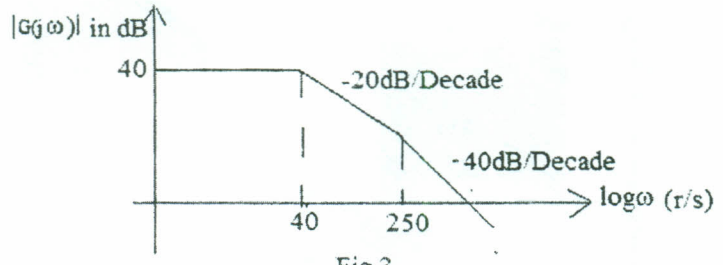

Fig.3

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

i)	Blooms Taxonomy Level – 1	20%
ii)	Blooms Taxonomy Level – 2	32.5%
iii)	Blooms Taxonomy Level – 3 & 4	47.5%

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