MANGALORE INSTITUTE OF TECHNOLOGY & ENGINEERING

(A Unit of Rajalaxmi Education Trust®, Mangalore)

Autonomous Institute affiliated to VTU, Belagavi, Approved by AICTE, New Delhi

Accredited by NAAC with A+ Grade & ISO 9001:2015 Certified Institution

Model Question Paper

Seventh Semester BE Degree Examination

Control Engineering

Time: 3 Hours (180 Minutes) **Max. Marks: 100**

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M: Marks, L: RBT (Revised Bloom's Taxonomy) level, C: Course outcomes.

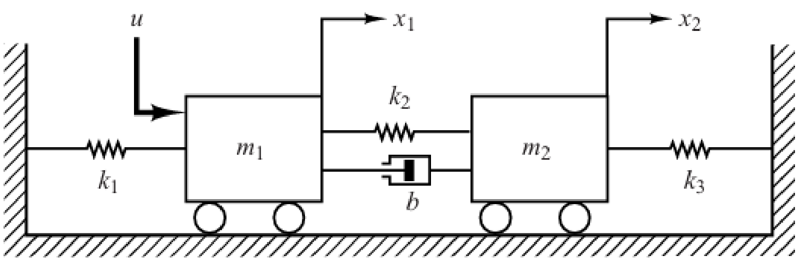
<table>
<tr><th colspan="3">Module -1</th><th>M</th><th>L</th><th>C</th></tr>
<tr><td rowspan="2">Q1</td><td>a.</td><td>Describe the Temperature Control System and the Business System with neat schematic diagrams.</td><td>10</td><td>L2</td><td>CO1</td></tr>
<tr><td>b.</td><td>Using the Ziegler–Nichols tuning rules for PID controllers, prove that the PID controller has a pole at the origin and double zeros at s=−1/L.</td><td>10</td><td>L3</td><td>CO3</td></tr>
<tr><th colspan="6">OR</th></tr>
<tr><td rowspan="2">Q2</td><td>a.</td><td>Explain Close loop control systems and Open loop control system.</td><td>10</td><td>L2</td><td>CO1</td></tr>
<tr><td>b.</td><td>Derive the Expressions for modification of PID Control Schemes.</td><td>10</td><td>L3</td><td>CO3</td></tr>
<tr><th colspan="6">Module- 2</th></tr>
<tr><td rowspan="2">Q3</td><td>a.</td><td>Obtain the transfer functions X1(s)U(s) and X2(s)U(s) of the mechanical system shown in Fig. (3a).


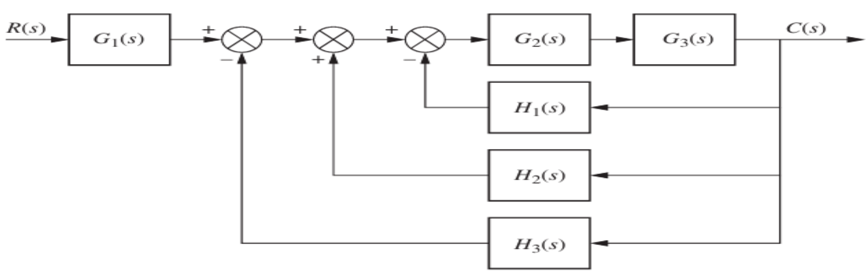
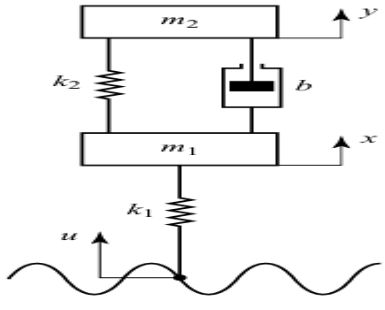
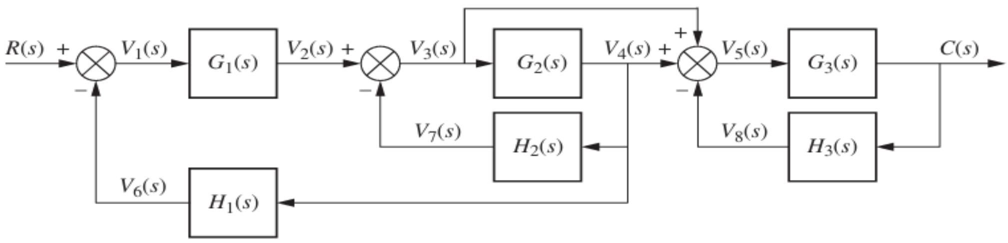
Fig.(3a)</td><td>10</td><td>L3</td><td>CO2</td></tr>
<tr><td>b.</td><td>Reduce the block diagram shown in Fig.(3b) to a single transfer function.


Fig.(3b)</td><td>10</td><td>L3</td><td>CO2</td></tr>
<tr><th colspan="6">OR</th></tr>
<tr><td>Q4</td><td>a.</td><td>Obtain the transfer function Y(s)/U(s) of the system shown in Fig(4a) The input u is a displacement input.</td><td>10</td><td>L3</td><td>CO2</td></tr>
</table>

		 Fig.(4a)			
	b.	Reduce the block diagram shown in Fig.(4b) to a single transfer function.  Fig.(4b)	10	L3	CO2
Module – 3					
Q5	a.	Consider the system where ζ=0.6 and ω_n=5 rad/sec Obtain the rise time , peak time ,maximum overshoot and settling when the system is subjected to a unit-step input.	06	L3	CO4
	b.	Consider the following negative feedback control system with a non-negative gain K. Solve the system using the Root Locus method. $$G(s) = \frac{K}{s(s+1)(s+2)}, \qquad H(s) = 1$$	14	L3	CO4
OR					
Q6	a.	Apply Routh's stability criterion to the following equations and determine the system stability. i) $S^4 + 2S^3 + 3S^2 + 4s + 5 = 0$	06	L3	CO4
	b.	Determine the values of gain K and velocity-feedback constant K_h so that the maximum overshoot in the unit-step response is 0.2 and the peak time is 1 sec. With these values of K and K_h obtain the rise time and settling time. Assume that J=1 kg-m^2 and B=1N-m/rad/ sec.	14	L3	CO4
Module – 4					
Q7	a.	Illustrate the stability of a control system using the Nyquist diagram.	08	L2	CO1
	b.	Draw the Bode plots for the system with the transfer function Where, G(s)= $\frac{K(S+3)}{[S(S+1)(S+2)}$.	12	L3	CO4
OR					
Q8	a.	Describe the concepts of gain margin and phase margin using the Nyquist diagram.	08	L2	CO1
	b.	Sketch the Nyquist diagram for the unity feedback control system with the open-loop transfer function, G(s)=$\frac{(S+2)}{S^2}$	12	L3	CO4

Module – 5						
Q9	a.	Determine the state-transition matrix for the following system and hence obtain the inverse of the state-transition matrix. $$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$	10	L3	CO5
	b.	Derive the condition for complete state controllability of continuous-time systems.	10	L3	CO5
OR						
Q10	a.	Determine the time response of the following system for the unit-step input, $$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u$$ Where u(t) is the unit-step function occurring at t=0 or u(t)=1(t).	10	L3	CO5
	b.	Determine the state-space representations of the given system in the controllable canonical form, observable canonical form, and diagonal canonical form. $$\frac{Y(s)}{U(s)} = \frac{s+3}{s^2+3s+2}$$	10	L3	CO5

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