**PVP 20**

Code: 20EE3501

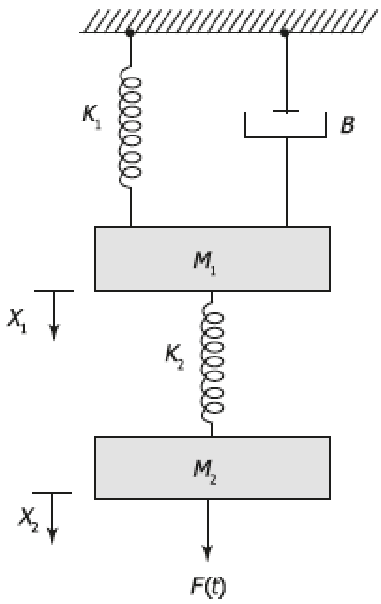
**III B.Tech - I Semester – Regular Examinations - DECEMBER 2022**

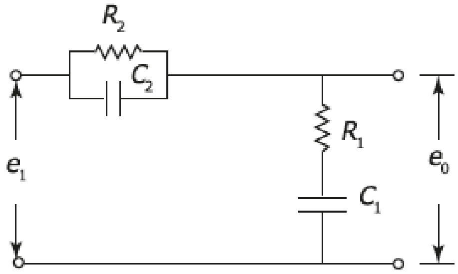
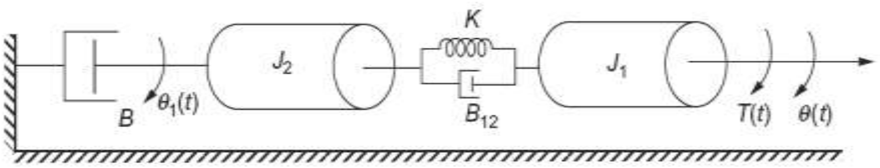
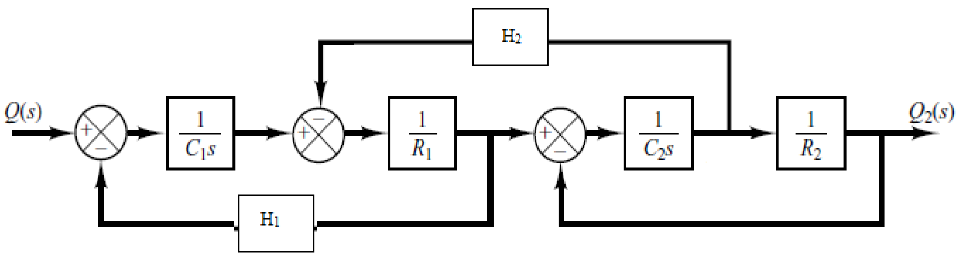
# CONTROL SYSTEMS
## (ELECTRICAL & ELECTRONICS ENGINEERING)

Duration: 3 hours Max. Marks: 70

Note: 1. This paper contains questions from 5 units of Syllabus. Each unit carries 14 marks and have an internal choice of Questions.
2. All parts of Question must be answered in one place.

BL – Blooms Level CO – Course Outcome

| | | | BL | CO | Max. Marks |
|---|---|---|---|---|---|
| | | **UNIT-I** | | | |
| 1 | a) | List out various classifications of control systems. Give an example for each classification. Also, discuss the advantages and drawbacks of open and closed loop systems. | L2 | CO1 | 6 M |
| | b) | Find the transfer function $X_2(s)/F(s)$ for the given mechanical translational system shown in the figure below.  | L3 | CO2 | 8 M |
| | | **OR** | | | |

<table>
<tr><td>2</td><td>a)</td><td>For the electrical network shown in figure, determine the transfer function $\frac{e_0(s)}{e_1(s)}$ using Laplace transformations.<br>
</td><td>L4</td><td>CO4</td><td>7 M</td></tr>
<tr><td></td><td>b)</td><td>For the mechanical rotational system shown in the figure below, find the transfer function $\frac{\theta(s)}{T(s)}$<br>
</td><td>L3</td><td>CO2</td><td>7 M</td></tr>
<tr><td colspan="6">UNIT-II</td></tr>
<tr><td>3</td><td>a)</td><td>Deduce the transfer function of armature controlled DC servo motor.</td><td>L4</td><td>CO4</td><td>6 M</td></tr>
<tr><td></td><td>b)</td><td>Draw the signal flow graph for the given block diagram and find the transfer function $\frac{Q_2(s)}{Q(s)}$ using Mason's Gain formula.<br>
</td><td>L3</td><td>CO3</td><td>8 M</td></tr>
<tr><td colspan="6">OR</td></tr>
<tr><td>4</td><td>a)</td><td>For the given signal flow graph, determine the transfer function using Mason's Gain formula.</td><td>L4</td><td>CO4</td><td>8 M</td></tr>
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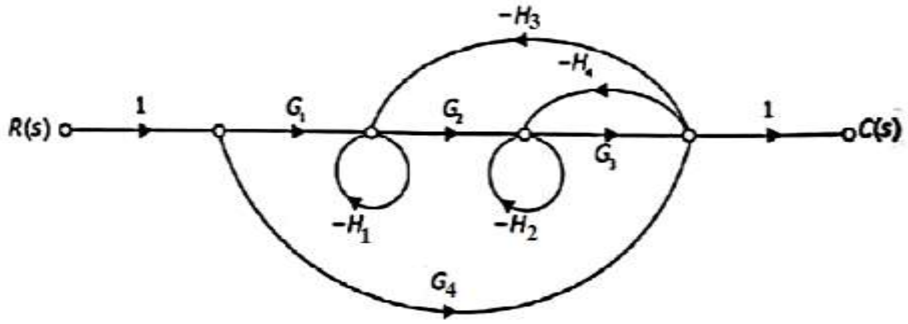
|---|---|---|---|---|---|
| | |  | | | |
| | b) | Discuss the block reductions rules for –<br>i) Shifting take-off point before the block<br>ii) Shifting summing point after the block<br>iii) Elimination of the feedback loop<br>iv) Interchanging summing points | L2 | CO1 | 6 M |
| **UNIT-III** | | | | | |
| 5 | a) | Derive the step response of first order system and plot its response. | L3 | CO3 | 7 M |
| | b) | Examine the stability for the given characteristic equation $S^4 + 3S^3 + 2S^2 + S + 1 = 0$. | L4 | CO4 | 7 M |
| **OR** | | | | | |
| 6 | | Sketch the root locus plot for the system with the open loop transfer function $G(s)H(s) = \frac{K(s+1)(s+2)}{(s+0.1)(s-1)}$.<br>Examine the system's stability. | L4 | CO4 | 14 M |
| **UNIT-IV** | | | | | |
| 7 | | A system is described by the following transfer function $G(s)H(s) = \frac{100(s+6)}{s(s+50)}$.<br>i. sketch the bode plot representing the magnitudes in dB and the phase angles in degrees.<br>ii. interpret gain and phase crossover frequencies from the obtained bode plot<br>iii. determine the phase margin, gain margin<br>iv. comment on the system's stability. | L4 | CO4 | 14 M |
| **OR** | | | | | |
| 8 | a) | Illustrate the frequency domain specifications and derive mathematical relations of all the frequency domain specifications. | L3 | CO3 | 8 M |

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|---|---|---|---|---|---|
| | b) | Discuss the procedure for plotting Bode plot. Also discuss the methodology in analyzing system's stability through bode plots. | L4 | CO4 | 6 M |
| **UNIT-V** | | | | | |
| 9 | a) | For the given transfer function $\frac{Y(s)}{U(s)} = \frac{24}{s^3 + 9s^2 + 26s + 24}$ Deduce its state space representation. | L4 | CO5 | 7 M |
| | b) | Using the expression for transforming a state model to its equivalent transfer function, find the transfer function for the state model given by $\dot{X}(t) = \begin{bmatrix} 0 & 1 \\ 1 & -2 \end{bmatrix}\begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ -1 \end{bmatrix}u(t)$ *and* $Y(t) = \begin{bmatrix} 0 & 1 \end{bmatrix}\begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$ | L3 | CO2 | 7 M |
| **OR** | | | | | |
| 10 | a) | The dynamics of a physical system is described by the differential equation $\frac{d^3y}{dt^3} + 5\frac{d^2y}{dt^2} + 9\frac{dy}{dt} + 6y = 10u$. Relate appropriate state variables and construct its equivalent state model. | L3 | CO2 | 7 M |
| | b) | A state model of a system is given as $\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -12 & -7 \end{bmatrix}\begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix}u(t)$ and $y = \begin{bmatrix} -10 & -4 \end{bmatrix}\begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + [1]u$ . Determine controllability and observability. | L4 | CO5 | 7 M |