U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

October 2022 Semester End Main Examinations

Programme: B.E. | **Semester: IV**

Branch: ECE / ETE / EEE / EIE | **Duration: 3 hrs.**

Course Code: 19ES4ESCST | **Max Marks: 100**

Course: Control Systems | **Date: 10.10.2022**

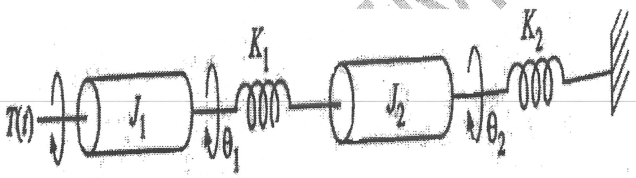
Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

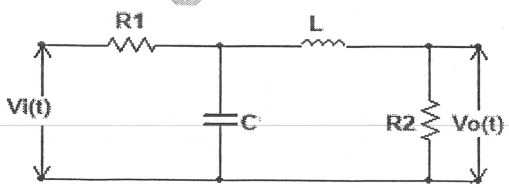
UNIT - I

1 a) Explain analogous systems **04**

b) For the mechanical system shown in figure, find the transfer function $\frac{\theta_2(s)}{T(s)}$ **08**

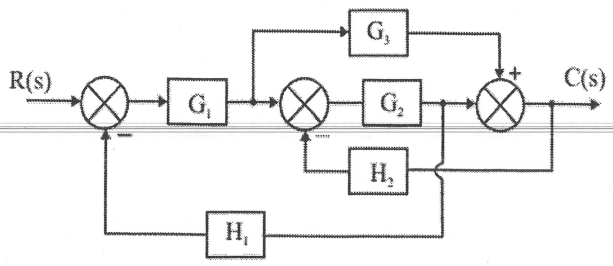


c) Find the transfer function for the following network using block diagram Transformations **08**

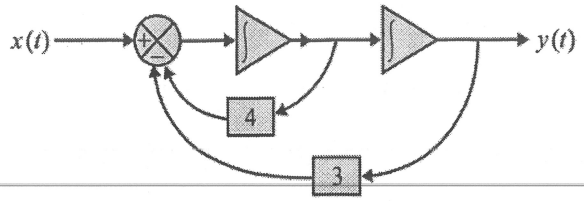


OR

2 a) For the system as shown in figure, draw the signal flow graph and hence find the transfer function **10**



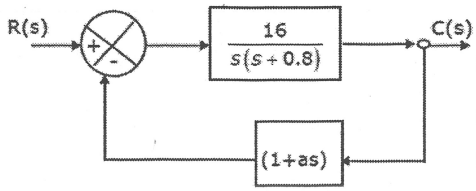
b) Find the transfer function of a LTI system whose block diagram is shown **05**



c) Differentiate between open-loop and closed-loop control systems **05**

UNIT - II

3 a) Consider the system shown in figure. Determine the value of 'a' such that the damping ratio is 0.5. Also obtain the values of the rise time 't_r' and maximum overshoot 'M_p' in its step response. **08**

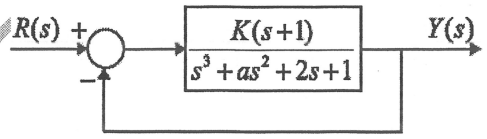


b) Measurements conducted on a servomechanism show the response to be $C(t) = 1 + 0.2e^{-60t} - 1.2e^{-10t}$ when subjected to a unit step. Obtain **06**
(i) Expression for the closed- loop transfer function
(ii) Undamped natural frequency and damping ratio of the system.

c) Define time response, error and different error constants **06**

UNIT - III

4 a) For the feedback system as shown, find the values of a and k so that the system oscillates at a frequency of 2 rad/sec **08**



b) The open loop transfer function of unity feedback system is given by $\frac{k(s+0.2)}{s^2(s+3.6)}$ **12**
Sketch the root locus of the system for all positive values of k

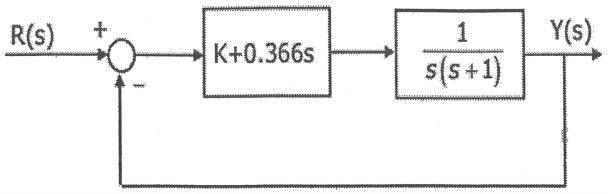
UNIT - IV

5 a) The open loop transfer function of a negative unity feedback system is given by $\frac{k(s+3)(s+5)}{(s-2)(s-4)}$. Using Nyquist criteria, find the range of '**K**' for closed loop stability. **12**

b) Explain the frequency domain specifications with a neat diagram. **08**

OR

6 a) The system shown in the figure has a phase margin of 60° at the crossover frequency of 1rad/sec, then find the value of the gain K **08**



b) The system has an open loop transfer function $G(s) = \frac{10k}{s(1+0.05s)(1+0.1s)}$. **12**

Using Bode plot, Find the gain k such that

(i) GM = 20dB (ii) PM = 10°

UNIT - V

7 a) A linear time-invariant system is characterized by state equation $\begin{bmatrix} \dot{x}1 \\ \dot{x}2 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix} \begin{bmatrix} x1 \\ x2 \end{bmatrix}$. **10**

Compute the solution of the state equation, assuming the initial vector $X_0 = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$

b) A feedback system has a closed-loop transfer function $\frac{Y(s)}{U(s)} = \frac{2(s+5)}{(s+2)(s+3)(s+4)}$. **10**

Find the state model of the system

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