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Code No.: EC405PC | R20 | H.T.No. | | | 8 | R | | | | | |

CMR ENGINEERING COLLEGE: : HYDERABAD
UGC AUTONOMOUS
II–B.TECH–II–Semester End Examinations (Supply) - February- 2024
CONTROL SYSTEMS
(ECE)

[Time: 3 Hours] **[Max. Marks: 70]**

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 20 marks. Answer all questions in Part A.

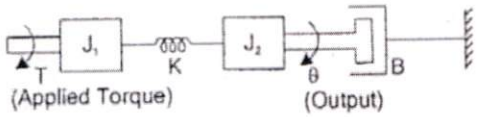
Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.

PART-A **(20 Marks)**

1. a) What is feedback? What type of feedback is employed in Control Systems? [2M]
   b) What are the basic properties of Signal flow graph? [2M]
   c) What is rise time? Mention its relevant formula. [2M]
   d) What are the necessary conditions for stability in RH criterion? [2M]
   e) What are the advantages of frequency response analysis? [2M]
   f) What is Polar Plot? [2M]
   g) What is the effect of PI and PID controllers? [2M]
   h) Why compensation is required in Control Systems? [2M]
   i) Define state and state variable. [2M]
   j) Briefly explain concept of observability? [2M]

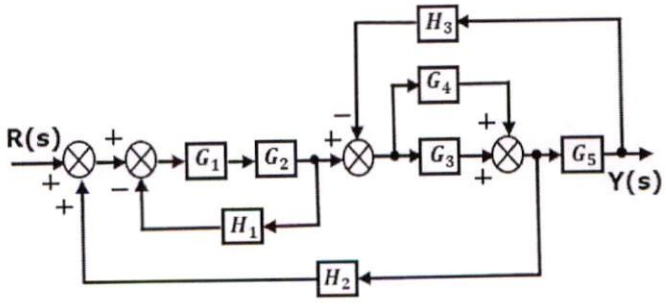
PART-B **(50 Marks)**

2. Write the differential equation governing the mechanical rotational system shown in figure below. Obtain the transfer function of the system. [10M]



OR

3. Find the transfer function Y(s)/R(s) of the system shown in below figure using Block diagram reduction technique. [10M]



4. A unity feedback control system has the forward transfer function [10M]

$$\frac{C(s)}{R(s)} = \frac{36}{s^2 + 2s + 36}$$

Find the response, damping ratio, rise time, peak time and the maximum peak over shoot for unit step input.

OR

5.a) What is root locus? Explain centroid and how to calculate the angle of asymptotes? [5M]

b) Using Routh Stability criterion determine the stability and location of roots on s-plane of the system characteristic equation is represented by $s^5+4s^4+8s^3+8s^2+7s+4=0$ [5M]

6. Sketch the Bode plot and determine the Phase Margin and Gain Margin for the open loop transfer function given [10M]

$$G(s) = \frac{8}{s(1+0.3s)(1+0.1s)}$$

OR

7. The open loop transfer function of the unity feedback system is given by [10M]

$$G(s)\,H(s) = \frac{10}{s(s+3)(s+6)}$$

Sketch the polar plot and determine the gain margin and phase margin.

8. Define Compensator? Explain the types of the compensators? [10M]

OR

9. A unity feedback system control system has the following forward transfer function [10M]

$$G(s) = \frac{K}{s^2(s+4)(s+12)}$$

Design a lead compensator to yield a closed loop step response with 20.5% overshoot and a settling time of 3 seconds.

10.a) Obtain the Eigen values and Eigen vectors for the given matrix. [5M]

$$A = \begin{pmatrix} 3 & 2 & 4 \\ 2 & 0 & 2 \\ 4 & 2 & 3 \end{pmatrix}$$

b) Obtain the state transition matrix from the state space representation. [5M]

$$\begin{bmatrix} \dot{x_1} \\ \dot{x_2} \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u$$

$$y = [1 \quad 0] \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

OR

11. Test the Controllability and Observability for the following state–space representation. [10M]

$$\dot{x} = \begin{bmatrix} -3 & 0 \\ 2 & -1 \end{bmatrix} x + \begin{bmatrix} 3 \\ 1 \end{bmatrix} u$$

$$y = [1 \quad 2]x$$

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