

**BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)**

CLASS: B.Tech.
BRANCH: EEE

SEMESTER : III/ADD
SESSION : MO/2025

SUBJECT: EE24207 INTRODUCTION TO SYSTEM THEORY

TIME: 3 Hours

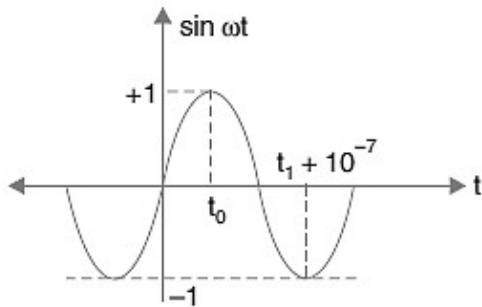
FULL MARKS: 50

INSTRUCTIONS:

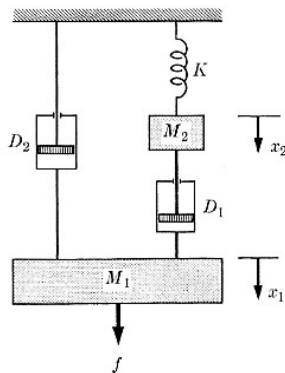
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
4. Before attempting the question paper, be sure that you have got the correct question paper.
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

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|---------------------------------------|-------|----|
| Q.1(a) Define a signal. | CO | BL |
| | [2] 1 | 2 |
| Q.1(b) Sketch the following function: | [3] 1 | 3 |

$$f(t) = \sin(\omega t) [u(t - t_0) - u(t - t_1 - 10^{-7})]; t_1 > t_0$$

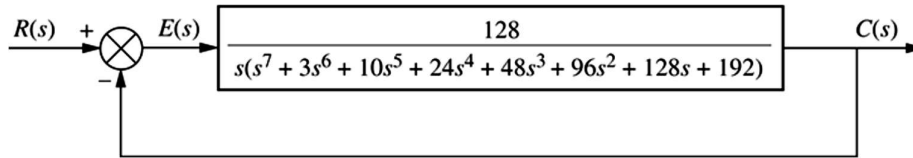


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| Q.1(c) Draw the electrical circuit analogous to the mechanical system of Fig. shown using force-current analogy. | [5] 3 | 3 |
|--|-------|---|



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|--|---------|---|
| Q.2(a) Determine the Fourier transform of $e^{-at} \sin(\omega_0 t), t \geq 0$. Sketch the relative frequency distribution. | [5] 2,4 | 3 |
| Q.2(b) A rectangular voltage pulse of unit height and duration T is applied to a series R - C combination at $t=0$. Determine the voltage across the capacitance C as a function of time using Laplace transform. | [5] 2,4 | 4 |
| Q.3(a) List and explain five specifications for a second-order underdamped system. | [5] 3,5 | 4 |
| Q.3(b) Find type, error coefficient and steady-state error of the system having unity feedback and open-loop transfer function $G(s) = \frac{K(s+4)}{s^2(s^3+8s^2+4)}$ when input is $\frac{A}{2}t^2$. | [5] | 4 |

- Q.4(a) If a Routh table has two sign changes above the even polynomial and five sign changes below the even polynomial, how many right-half-plane poles does the system have? [2] 5 4
- Q.4(b) What do you mean by stability? [3] 5 2
- Q.4(c) Find the number of poles in the left half-plane, the right half-plane, and on the $j\omega$ -axis for the system of the Figure shown below. Draw conclusions about the stability of the closed-loop system. [5] 4 4



- Q.5(a) Briefly describe an advantage that state-space techniques have. [5] 4 2
- Q.5(b) The state equation of a linear time-invariant system is given below: [5] 4 4
- $$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -6 & -5 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u, \quad x(0) = \begin{bmatrix} 1 \\ 0 \end{bmatrix} \text{ and } y = [1 \quad 0] x$$

Obtain the output time response of the system at $t = 1$ second when subjected to a unit step input.

::::24/11/2025::::E