

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

CLASS: BE
BRANCH: MECH

SEMESTER: VII/ADD
SESSION : MO/2019

SUBJECT : EE3201 INTRODUCTION TO SYSTEM THEORY

TIME: 1.5 HOURS

FULL MARKS: 25

INSTRUCTIONS:

1. The total marks of the questions are 30.
2. Candidates may attempt for all 30 marks.
3. In those cases where the marks obtained exceed 25 marks, the excess will be ignored.
4. Before attempting the question paper, be sure that you have got the correct question paper.
5. The missing data, if any, may be assumed suitably.

Q1 (a) Define the following: Causal and Noncausal Systems. Give one example of each. [2]

(b) Check whether the system given by $\frac{d^3 y(t)}{dt^3} + 4 \frac{d^2 y(t)}{dt^2} + 5 \frac{dy(t)}{dt} + 2y(t) = x(t)$ is linear or nonlinear. [3]

Q2 (a) For the signal given in Fig-1, draw the following signals: [2]

- (i) $x(t)u(1-t)$ (ii) $x(t)[u(t)-u(t-1)]$ (iii) $x(t)u(t-1)$ (iv) $x(t)\delta(t-1.5)$

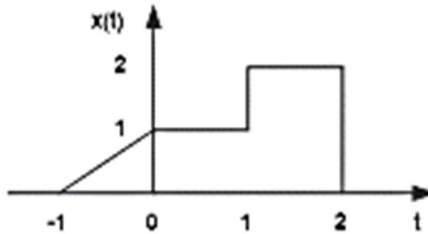
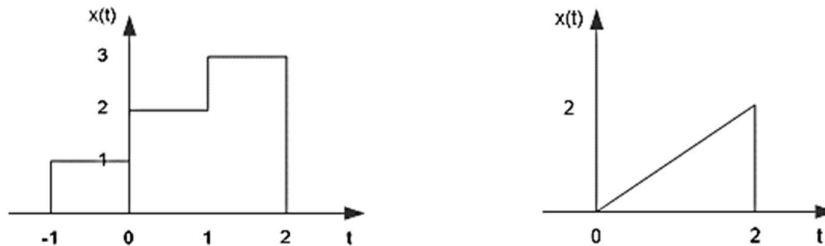


Fig-1

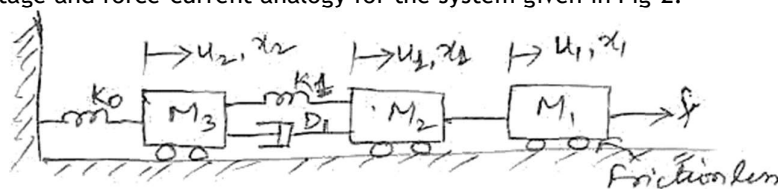
(b) (i) Represent the following signals in terms of unit step signals: [3]



(ii) If a signal $x(t)$ is given by $x(t) = \cos t + \sin t + \sin t \cos t$, determine the even and odd components of the signal.

Q3 (a) Establish the analogy between electrical and mechanical systems. [2]

(b) Write the equilibrium equation and obtain the equivalent analog electrical system using force-voltage and force-current analogy for the system given in Fig-2. [3]



- Q4 (a) Explain the dual systems. [2]
 (b) Obtain the electrical analog for a one-tank liquid level system of your choice. Also develop its transfer function. [3]

- Q5 (a) Show that the Laplace transform of a periodic function with period T is equal to $\frac{1}{1 - e^{-Ts}}$ [2]
 times the Laplace transform of the first cycle.
 (b) State and prove the initial value theorem. [3]

For the given Laplace transform

$$Y(s) = \frac{17s^3 + 7s^2 + s + 6}{s^5 + 3s^4 + 5s^3 + 4s^2 + 2s},$$

Find the initial and final values of the corresponding time function y(t).

- Q6 (a) Write the Laplace transform of the following functions and mention the property which is used. [2]
 (i) $3t + 4 \exp(-2t)$ (ii) $t \exp(at)$
 (b) Obtain the inverse Laplace transform of the functions given by [3]
 (i) $\frac{20}{s(s^2 + 10s + 9)}$ (ii) $\frac{2(s+2)}{s^2 + 4s + 13}$

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