

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 1253

Roll No.

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**B.Tech.**

(SEM. III) ODD SEMESTER THEORY

EXAMINATION 2013-14

**BASICS OF SIGNALS AND SYSTEMS**

*Time : 3 Hours*

*Total Marks : 100*

**Note :-** Attempt questions from all Sections as per directions.

**SECTION-A**

1. Attempt all parts : (2×10=20)
- (a) What is the difference between continuous-time and discrete-time signals ?
  - (b) Define unit impulse function  $\delta(t)$ .
  - (c) Explain the analogy between mechanical and electrical systems.
  - (d) What are the dirichlet conditions for the existence of Fourier Series ?
  - (e) Find the Fourier transform of Unit-Step function.
  - (f) Prove the time-shift property for Laplace transform.
  - (g) Explain the applications of Laplace transform.

- (h) Explain the terms 'state' and 'state variables' with examples.
- (i) List the advantages of state space representation of Linear Systems.
- (j) Explain initial and Final Value Theorem for z-transform.

### SECTION-B

2. Attempt **three** parts : (3×10=30)

- (a) Express the signal shown in Fig. 1 in terms of step signals.

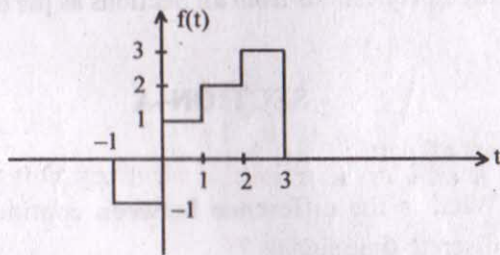


Fig. 1

- (b) Draw the force-current analogy of the mechanical system shown in Fig. 2.

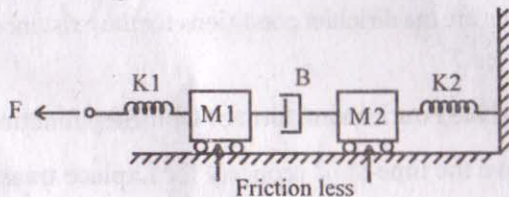


Fig. 2

- (c) Find the Fourier transform of signal shown in Fig. 3.

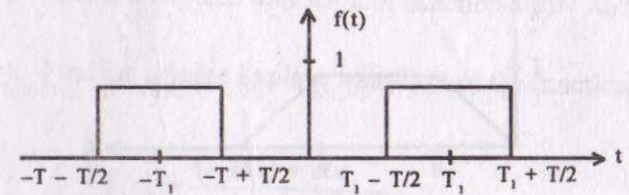


Fig. 3

- (d) Find the inverse Laplace transform of following function :

$$F(s) = \frac{3s^2 + 8s + 6}{(s + 2)(s^2 + 2s + 1)}$$

- (e) Define the state transition matrix and its properties.

### SECTION-C

Note :- Attempt **all** questions from this Section. (10×5=50)

3. Attempt any **two** parts of the following :

- (a) Distinguish between Periodic and Non-periodic Signals.

Find the time-period of the signal  $x(t) = \cos \frac{\pi}{3}t + \sin \frac{\pi}{4}t$ .

(b) Synthesize the signal (Fig. 4) using basic signals.

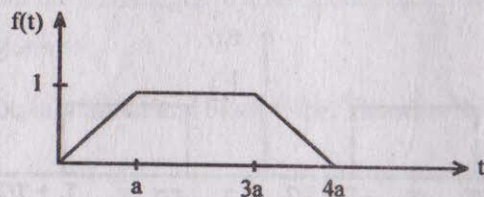


Fig. 4

(c) What is a LT1 system? Check whether the system  $y(t) = x^2(t)$  is a LT1 system.

4. Attempt any one part of the following :

(a) Determine the Fourier series for a square wave signal of unity magnitude using trigonometric series.

(b) Find the exponential Fourier series of the signal shown in Fig. 5 :

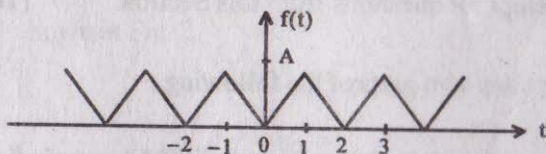


Fig. 5

5. Attempt any two parts of the following :

(a) Find the Laplace transform of function  $x(t) = Ae^{-a|t|}$ .

(b) Find the inverse Laplace transform of the function :

$$F(s) = \frac{(s+1) + 3e^{-4s}}{(s+2)(s+3)}$$

(i) ROC :  $\text{Re}\{s\} > 3$

(ii) ROC :  $\text{Re}\{s\} < 2$ .

(c) Consider the circuit shown in Fig. 6. Initially the switch is in position 1. At  $t = 0$ , the switch is moved to position 2. Find the expression for the current in the inductor L.

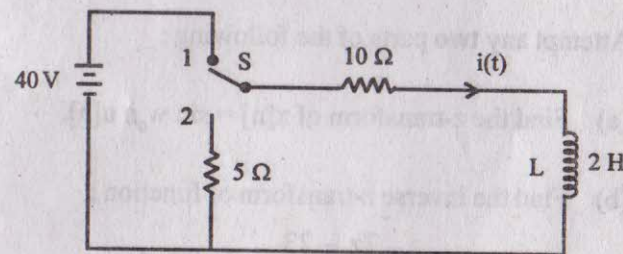


Fig. 6

5. Attempt any **one** part of the following :

(a) State space representation of a system is given by :

$$\dot{X}(t) = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} x(t) + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u(t), \quad y(t) = [1 \quad 0] x(t)$$

where  $u(t)$  is the unit step input. All the initial conditions are zero. Find the time-response of the system.

(b) Develop the state model for the circuit shown in Fig. 7 :

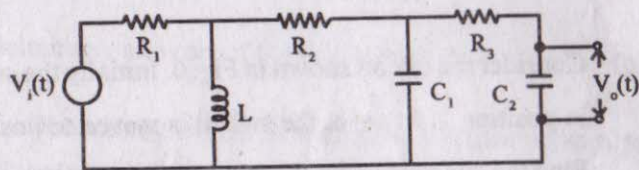


Fig. 7

7. Attempt any **two** parts of the following :

(a) Find the z-transform of  $x[n] = \sin \omega_0 n u[n]$ .

(b) Find the inverse z-transform of function :

$$X(z) = \frac{7z - 23}{(z-3)(z-4)} \quad |z| > 4.$$

(c) Find the response of the following difference equation for step input. Assume zero initial conditions :

$$y[n] - \frac{5}{6} y[n-1] + \frac{1}{6} y[n-2] = x[n] - \frac{1}{2} x[n-1].$$