

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

PAPER ID : 0208

Roll No.

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B. Tech

(SEMESTER-III) THEORY EXAMINATION, 2012-13

BASIC SYSTEM ANALYSIS

Time : 3 Hours]

[Total Marks : 100

Note : Attempt **all** questions.

Section – A

1. Answer **all** parts of this section : **2 × 10 = 20**

- (a) Define Z-transform and write its properties.
- (b) What do you mean by “continuous + ive signals” ?
- (c) Write “FINAL VALUE THEOREM” in Laplace Transform domain.
- (d) What do you understand by “STATE TRANSITION MATRIX” ? Also mention its properties.
- (e) State “INVERSE LAPLACE TRANSFORM”.
- (f) Enlist f-i analogy of a given mechanical systems.
- (g) What do you understand by “FIRST” and “SECOND” order systems ?
- (h) What do you mean by solution of difference equations in Z-transform domain ?
- (i) Define “STATE” and “STATE VARIABLES” in state space representations.
- (j) What are the properties by FOURIER INTEGRALS ?

Section – B

2. Answer any **three** parts of the following : **3 × 10 = 30**

- (a) What do you mean by “ANALOG” and “DIGITAL” signals ? Also mention its advantages and disadvantages. Give their physical examples.

- (b) Derive the Laplace transform of the waveform as shown in fig. 1.

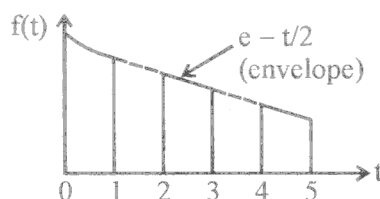


Fig. – 1 Waveform

- (c) 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 value of the corresponding time function $y(t)$.

- (d) Determine the Fourier transforms and amplitude spectrums of the following functions :
- $f(t) = \exp(-a|t|)$ for all values of t .
 - $f(t) = 1, -\infty < t < \infty$
 - Unit impulse function, $\delta(t)$.
 - Unit signum function, $\text{Sgn}(t) = -1, t < 0$
 $= 1, t > 0$
- (e) Draw the electric analogy, by f-v and f-I analogy, of the mechanical system shown in fig. 2. Write the equilibrium equations of the mechanical system.

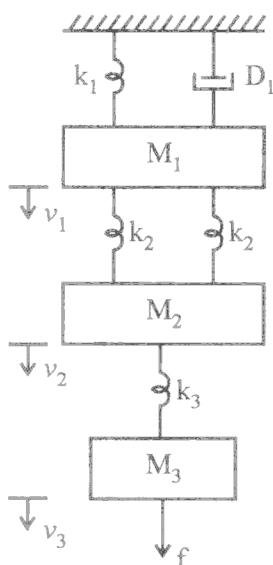


Fig. – 2 Mechanical System

Answer all questions :

5 × 10 = 50

3. What do you mean by “FOURIER TRANSFORM” and “INVERSE FOURIER TRANSFORM” ? Also mention its advantages and disadvantages.

OR

What do you understand by “LAPLACE TRANSFORM” ? Also mention its advantages and disadvantages. Enlist any five applications of Laplace transforms.

4. Explain the following :

- (i) ELECTRO-MECHANICAL SYSTEMS
- (ii) PERIODIC SIGNALS

OR

Find $L^{-1}[F_1(s) \cdot F_2(s)]$ by using convolution integral theorem for the following functions :

- (i) $F_1 = \frac{1}{s(s+1)}$; $F_2 = \frac{1}{(s+3)}$
- (ii) $F_1 = \frac{1}{(s+a)}$; $F_2 = \frac{1}{(s+b)(s+c)}$

5. The natural response of a certain system is described by the homogeneous state equations :

$$\frac{dy_1}{dt} + 7y_1 - y_2 = 0, \text{ and}$$

$$\frac{dy_2}{dt} + 12y_1 = 0$$

Determine the state transition matrix of system.

OR

Consider the system described by

$$\ddot{y} + 3\dot{y} + 2y = u$$

Derive the state space representation. Choose the state variables such that the system matrix becomes diagonal.

6. The unit step response of a system is given by $(1 - e^{-bt})$. Determine the unit impulse and unit ramp response $h(t)$ of the system.

OR

Show that trigonometric Fourier series of the wave form as shown in fig. 3 can be written as :

$$f(t) = \frac{1}{2} + \frac{6}{\pi} \sum_{p=0}^{\infty} \frac{1}{2p+1} \sin \frac{(2p+1)t}{L}$$

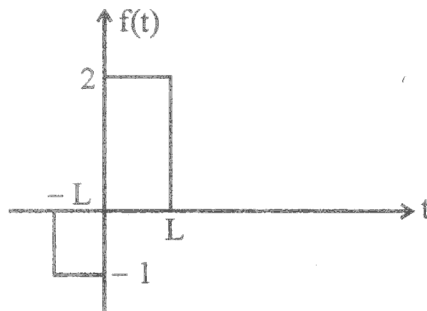


Fig. – 3 Waveform

7. A series R-L-C circuit with $R = 5\Omega$, $L = 5 \text{ mH}$; $C = 50 \mu\text{f}$ has an applied voltage $V(t) = 150 \sin 1000 t + 100 \sin 200 t + 75 \sin 3000 t$. Determine the effective current and average power.

OR

Calculate the impedance, resistance, power and power factor of a circuit whose expression for voltage and current are given by :

$$v = 100 \sin (wt + 60^\circ) - 50 \sin (3wt - 30^\circ) \text{ volts}$$

$$i = 10 \sin (wt + 60^\circ) + 5 \cos (3wt + 60^\circ) \text{ amps}$$