Exam.Code:0927
Sub. Code: 6898

1078

B.E. (Electronics and Communication Engineering)
Third Semester
EC-302: Signals and Systems

Time allowed: 3 Hours | Max. Marks: 50

NOTE: *Attempt five questions in all, including Question No. 1 which is compulsory and selecting two questions from each Part. Use of scientific calculators is allowed.*

x-x-x

I. (a) What is the significance of elementary signals? **(1)**
(b) What is pole-zero plot? What is its significance? **(2)**
(c) Is it possible to compress a signal in time domain and frequency domain simultaneously? Explain. **(2)**
(d) What is a non-causal system? **(1)**
(e) Describe the concept of Region of Convergence. **(2)**
(f) What are advantages of using Laplace transform over Fourier transform? **(2)**

Part- A

II. (a) Determine the fundamental frequency of the following signal

$$x(t) = 2 + 7\cos\left(\frac{1}{2}t + \theta_1\right) + 3\cos\left(\frac{2}{3}t + \theta_2\right) + 5\cos\left(\frac{7}{6}t + \theta_3\right).$$ **(2)**

(b) Define deterministic and random signals. **(2)**
(c) What are the limitations of using Fourier series for analyzing linear systems? Can we overcome these limitations? **(3)**
(d) State and explain sampling theorem. Determine the Nyquist rate and Nyquist interval for the following signal:

$$x(t) = 4\cos 50\pi t + 30\sin 300\pi t - 5\cos 150\pi t$$ **(3)**

III. (a) Determine the Fourier transform of function $x(t) = rect\left(\frac{t}{\tau}\right)$. What is the bandwidth of this signal? **(4)**
(b) Sketch the following signals
(1) $x_1(t) = u(t-5) - u(t-7)$.
(2) $x_2(t) = u(t-5) + u(t-7)$. **(2)**

(c) Find the unit impulse response of a linear time invariant continuous (LTIC) system specified by the equation:

$$(D^2 + 4D + 3)y(t) = (D+5)x(t)$$

where $D = \frac{d}{dt}$ is the differential operator. **(4)**

P.T.O.

IV. (a) For the systems described by the equations below, with the input $x(t)$ and output $y(t)$, determine which of the systems are time-invariant and which are time-varying systems:

(1) $y(t) = x(t-2)$

(2) $y(t) = x(-t)$ **(3)**

(b) Describe the concept of negative frequency. **(2)**

(c) Explain time shifting property of Fourier transform. What is its significance? Using this property, show that if $f(t) \Leftrightarrow F(\omega)$ are Fourier transform pair, then

$$f(t+T) + f(t-T) \Leftrightarrow 2F(w) \cdot \cos \omega T.$$ **(5)**

Part- B

V. (a) Explain the following properties of discrete time Fourier transform:

(1) Frequency shifting property

(2) Time and frequency convolution property **(6)**

(b) Find the Laplace transforms and the region of convergence of the following functions:

(1) $u(t) - u(t-2)$

(2) $te^{-t}u(t)$ **(4)**

VI. (a) Define unilateral Laplace transform. **(2)**

(b) Define Hilbert transform. **(3)**

(c) Explain the condition under which Z-transform of a signal can exist. Find the inverse Z-transform of the function $\dfrac{2z(3z+17)}{(z-1)(z^2-6z+25)}$. **(5)**

VII. (a) Find the inverse Z-transform of $F[z] = \dfrac{(e^{-2}-2)z}{(z-e^{-2})(z-2)}$ if the region of convergence is:

(1) $|z| > 2$

(2) $e^{-2} < |z| < 2$

(3) $|z| < e^{-2}$. **(6)**

(b) Applying Laplace transform, find the current through the RC circuit in figure 1 if the applied voltage $x(t)$ is given as

$$x(t) = e^{t}u(t) - e^{2t}u(-t)$$ **(4)**

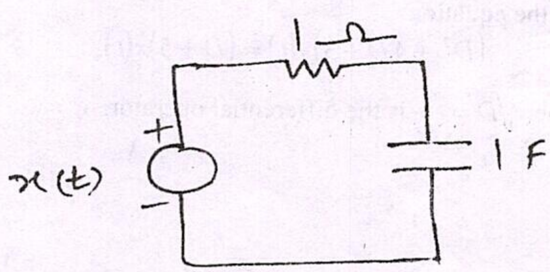

fig 1.