

Fourth Semester B.E. Degree Examination, June/July 2017

Signals and Systems

Time: 3 hrs.

Max. Marks: 100

Note: Answer FIVE full questions, selecting at least TWO questions from each part.

PART – A

- 1 a. Discuss the classification of signals with example. (07 Marks)
 b. Derive an expression to find even and odd components of continuous time signal. (04 Marks)
 c. For the CTS $x(t)$ shown in Fig.Q1(c), sketch (i) $x(3t + 2)$, (ii) $x(3t) + x(3t + 2)$.

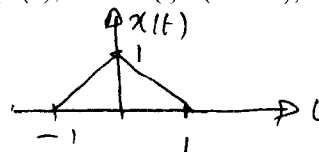


Fig.Q1(c)

- (04 Marks)
- d. Determine whether following signals are periodic or not, if periodic find the fundamental period, (i) $x(t) = \{\cos(2\pi t)\}^2$, (ii) $x(n) = \cos 2n$. (05 Marks)
- 2 a. Verify whether the following system is linear, time invariant, memoryless, causal and stable $y(t) = at^2x(t) + bt x(t-4)$. (07 Marks)
 b. Compute the convolution of $x_1(n) = \{2, 3, 4\}$ and $x_2(n) = \{1, 2, 3, 4\}$. (03 Marks)
 c. Compute the convolution of the following : $x(t) = e^{-4t}[u(t) - u(t-2)]$, $h(t) = e^{-2t}u(t)$. (10 Marks)
- 3 a. Find the step response for the LTI system represented by impulse response $h(u) = \left(\frac{1}{4}\right)^n u(n)$. (03 Marks)
 b. Find the forced response of the system given by $5 \frac{dy}{dt} + 10y(t) = 2x(t)$ with $x(t) = 2u(t)$. (05 Marks)
 c. Find the response of the system described by the difference equation $y(n) - \frac{1}{9}y(n-2) = x(n-1)$ with $y(-1) = 1$, $y(-2) = 0$ and $x(n) = U(n)$. (07 Marks)
 d. Draw the direct form I and direct form II implementation for $\frac{d^2y(t)}{dt^2} + 4 \frac{dy(t)}{dt} + 5y(t) = \frac{dx(t)}{dt}$. (05 Marks)
- 4 a. Prove the following properties of DTFS:
 i) Convolution in time domain
 ii) Modulation theorem. (08 Marks)
 b. Determine the DTFS coefficients of $x(n) = \cos\left(\frac{6\pi}{13}n + \frac{\pi}{6}\right)$. Draw magnitude and phase spectrum. (06 Marks)

- c. Determine the time domain signal corresponding to the following spectra:

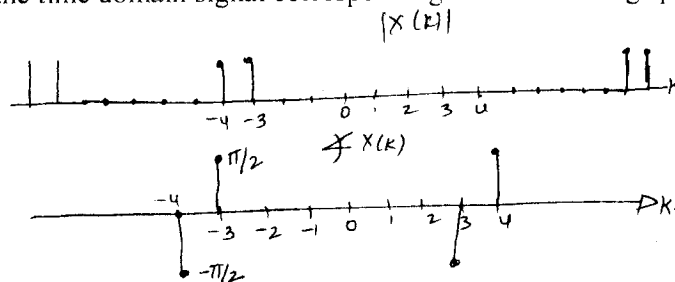


Fig.Q4(c)

(06 Marks)

PART – B

- 5 a. Prove time property of discrete time aperiodic sequences. (03 Marks)
 b. Determine DFT of $x(n) = a^n u(n)$ and plot magnitude and phase plot. (05 Marks)
 c. Determine the time domain expression of :

$$\text{i) } X(e^{j\Omega}) = \frac{3 - \frac{1}{4}e^{-j\Omega}}{-\frac{1}{16}e^{-j2\Omega} + 1}$$

$$\text{ii) } X(e^{j\Omega}) = \frac{6}{e^{-j2\Omega} - 5e^{-j\Omega} + 6}$$

$$\text{iii) } X(e^{j\Omega}) = \frac{6 - \frac{2}{3}e^{-j\Omega} - \frac{1}{6}e^{-j2\Omega}}{-\frac{1}{6}e^{-j2\Omega} + -\frac{1}{6}e^{-j\Omega} + 1}$$

(12 Marks)

- 6 a. A causal and LTI system has frequency response, $H[j\omega] = H[\omega] = \frac{j\omega + 4}{6 - \omega^2 + 5j\omega}$.
 i) Obtain the differential equation for the system.
 ii) Determine the impulse response $h(t)$ of s.
 iii) What is the output of s if $x(t) = e^{-4t}u(t) - te^{-4t}u(t)$? (10 Marks)
 b. The input and output of a causal LTI system are related by differential equation:

$$\frac{d^2 y(t)}{dt^2} + 6 \frac{dy(t)}{dt} + 8y(t) = 2x(t)$$

- i) Find $h(t)$.

- ii) Find the response of the system for $x(t) = t \cdot e^{-2t}u(t)$. (10 Marks)

- 7 a. Prove the time shifting and differentiation properties of z-transform. (06 Marks)
 b. Determine the z-transform and ROC of the following sequence $x(n) = -a^n u(-n-1)$. (04 Marks)

- c. Find the inverse z-transform of $X(z) = \frac{1}{1 - 1.5z^{-1} + 0.5z^{-2}}$ for (i) $|z| > 1$, (ii) $|z| < 0.5$. (10 Marks)

- 8 a. A causal system has input $x(n]$ and output $y(n]$. Find the impulse response of the system:

$$x(n) = \delta(n) + \frac{1}{4}\delta(n-1) - \frac{1}{8}\delta(n-2); \quad y(n) = \delta(n) - \frac{3}{4}\delta(n-1) \quad (10 \text{ Marks})$$

- b. Solve the difference equation for the given initial conditions and input using unilateral z-transform. $y(n) - \frac{1}{9}y(n-2) = x(n-1)$ with $y(-1) = 0$, $y(-2) = 1$ and $x(n) = 3u(n)$. (10 Marks)
