Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Fifth Semester B.Tech Degree (S,FE) Examination January 2022 (2015 Scheme)

Course Code: EE307

Course Name: SIGNAL AND SYSTEMS

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions, each carries 5 marks. Marks

1 Check whether the system $y(t) = x\left(\frac{t}{2}\right)$ is dynamic, linear and time invariant (5)

2 Find the Laplace transform of the function $x(t) = \sqrt{2}cos(3t + 45°)u(t)$. Also specify the ROC. (5)

3 State and prove the Frequency shifting and Convolution properties of Fourier Transform. (5)

4 State and prove sampling theorem. (5)

5 State and prove the scaling and time shifting properties of z-transform (5)

6 Find the z-transform of $x[n] = 3\alpha^n u[-n]$. Indicate ROC, poles and zeros in z-plane. (5)

7 Explain any five types of non-linear systems. (5)

8 State any 5 properties of Discrete Fourier series. (5)

PART B

Answer any two full questions, each carries10 marks.

9 Consider the signal $x(t) = \begin{cases} t+2, -2 \le t \le -1 \\ 1, -1 \le t \le 1 \\ -t+2, 1 \le t \le 2 \\ 0, elsewhere \end{cases}$

a) Write a mathematical equation for $y(t) = x(-2t - 3)$.and sketch y(t). (6)

b) Find the total energy of y(t). (4)

10 a) Define signum function. (2)

b) Find the convolution of $x_1(t)$ and $x_2(t)$ given $x_1(t) = e^{-2t}u(t)$ and $x_2(t) = e^{-5t}u(t)$. (3)

c) Determine the initial and final values for the given Laplace transform. (5)

$$X(s) = \frac{5s + 4}{s^2 + 3s + 2}$$

11 a) Determine the response of the LTI system described by the differential equation (5)

$$\frac{d^2y(t)}{dt^2} + 5\frac{dy(t)}{dt} + 4y(t) = 3x(t)$$

due to the input $x(t) = e^{-2t}u(t)$. Given that y(0) = 1 and $\left.\frac{dy(t)}{dt}\right|_{t=0} = -1$

b) Plot the pole-zero diagram of the system given by the transfer function (5)

$$X(s) = \frac{s+3}{s^3 + 7s^2 + 24s + 18}$$

Also specify the ROC for this system is causal and stable, Justify your answer.

PART C

Answer any two full questions, each carries10 marks.

12 Obtain the trigonometric Fourier series coefficient of the periodic function shown below. (10)

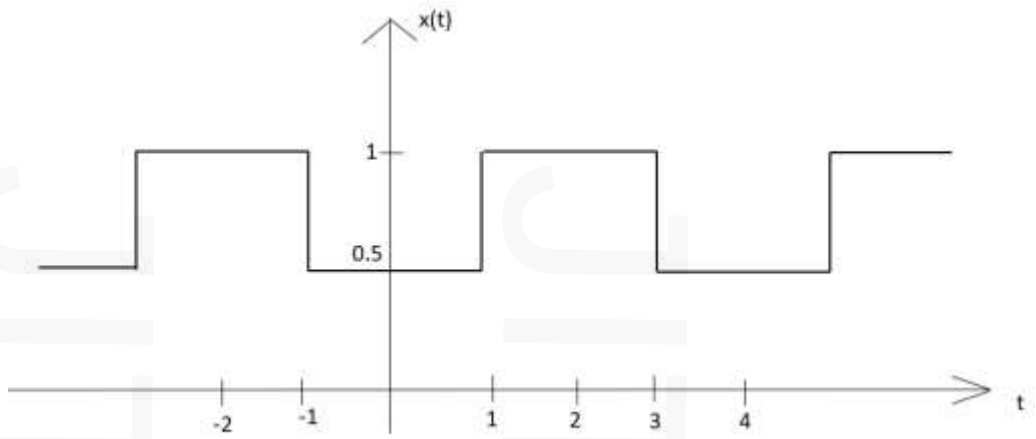

Fig.1

13 a) Find the frequency response and impulse response of the system described by the differential equation (5)

$$\frac{d^2y(t)}{dt^2} + 5\frac{dy(t)}{dt} + 6y(t) = x(t) + 3\frac{dx(t)}{dt}$$

b) Explain aliasing. (2)

c) An analog signal is expressed by the equation, $x(t) = 3cos(10\pi t) + sin(50\pi t)$. (3)

Calculate the Nyquist rate in Hz for this signal.

14 Consider an LTI system with unit impulse response (10)

$$h[n] = \beta^n u[n], |\beta| < 1$$

Compute the output signal y[n] for an input

$$x[n] = u[n+12] - 2u[n+4] + u[n-7].$$

PART D

Answer any two full questions, each carries 10 marks.

15 a) Obtain the time domain signal corresponding to the following z transform. (5)

$$X(z) = \frac{(2z-7)}{(z-3)(z-2)} with ROC |z| < 2$$

b) Find the z transform of the signal x[n] = (sin ω_0n)u[n] and find ROC. (5)

16 a) Determine the impulse response corresponding to the following transfer function if the system is stable (5)

$$H(z) = \frac{3 - 4z^{-1}}{1 - 3.5z^{-1} + 1.5z^{-2}}$$

b) What is random signal? Give an example. (5)

17 a) Find the Discrete Fourier series representation of x[n] =cos$\frac{2\pi}{8}n$. (5)

b) Find the magnitude and phase response of the causal system y[n] - y[n-1] +$\frac{3}{16}$y[n-2] = x[n] - 0.5x[n-1]. (5)

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