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Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Fourth Semester B.Tech Degree Examination June 2022 (2019 scheme)

Course Code: ECT204

Course Name: SIGNALS AND SYSTEMS

Max. Marks: 100 Duration: 3 Hours

PART A

(Answer all questions; each question carries 3 marks) Marks

1 Sketch the signal $x(t) = [e^{-t}u(t)] \sum_{n=-\alpha}^{\alpha} \delta(t - nT)$ where T is any positive integer. 3

2 What is the output sequence of an LTI system with impulse response h(n)=[2 , 2] to the input x(n)=[1, 2,3, 1]? 3

3 State the Dirichlet's conditions for the convergence of Fourier series. 3

4 Prove time-shifting property of Laplace transform. 3

5 A continuous time signal $x(t) = cos\ 40t - cos\ 60t$ is sampled with a time period T. Can $x(t)$ be recovered from the samples $x(nT)$ for $= \pi/30$? State the reason for the same. 3

6 Find the frequency response $H(\omega)$ and impulse response of an LTI system characterized by the differential equation 3

$$\frac{dy(t)}{dt} + ay(t) = x(t); a > 0$$

7 Define Energy Spectral Density of a discrete time signal? How can you relate it to the DTFT of the signal? 3

8 Determine the Fourier series coefficients of the signal 3

$x(n) = 2 + \cos\left(\frac{\pi}{3}n + \frac{\pi}{4}\right)$.

9 If the ROC of system function of an LTI system is **|z| >0.8,** comment on the stability and causality of the system with proper justification. 3

10 Give the relation between DTFT and z-transform of a discrete time signal. 3

PART B

(Answer one full question from each module, each question carries 14 marks)

Module -1

11 a) Determine whether the following system is static , time invarient, linear and causal. (x and y denote input and output respectively). Give explanation for each. 8

$$y(t) = t^2\, x(t) + x(t-2)$$

b) Check whether the following signals are energy or power signals. 6

i) $x(t) = e^{-a|t|}$; a>0

ii) $x(t) = tu(t)$

12 a) Find the output of an LTI system with impulse response h(t) to the input x(t). 8

Given $x(t) = u(t) - u(t-2)$ and h(t) is shown in Figure 1.

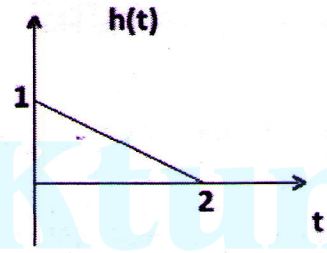

Figure 1

b) Sketch the signals (i) $y(t) = u(0.5t + 2)$ (ii) $y(n) = u(n) + u(n-5)$ 6

Module -2

13 a) 8

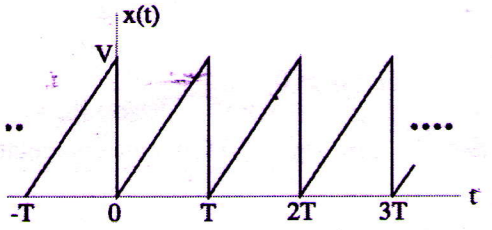

Figure 2

Find the complex exponential Fourier series of the periodic signal shown in Figure 2.

b) If $x(t)$ has a Fourier Transform , find the Fourier Transform of 6

i) $x_1(t) = x(4t-3)$

ii) $x_2(t) = \frac{d}{dt}x(t-3)$

14 a) Find the Fourier Transform of the signal $x_1(t)$ shown in Figure 3 using convolution property and time shift property of Fourier Transform. 8

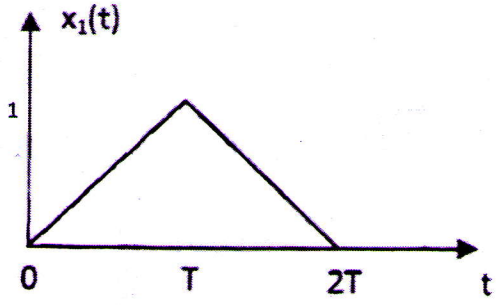

Figure 3

b) Find the Laplace Transform and ROC of the signal 6

$$x(t) = (e^{-2t} + 3e^{-3t})u(t)$$

Module -3

15 a) Find the impulse response and step response of a system with transfer function 7

$$H(s) = \frac{3s}{2s^2 + 10s + 12}$$

b) Determine the Nyquist rate of sampling for the signals 7

i) $x(t) = cos\ (150\pi t)\sin\ (50\pi t)$

ii) $x(t) = sin(150\pi t) + sinc^2\ (150\pi t)$

16 a) A continuous time LTI system is described by the differential equation 7

$$\frac{dy(t)}{dt} + 5y(t) = x(t)$$

Determine the response of the system to the input $x(t) = e^{-2t}u(t)$using Fourier Transform.

b) Consider the continuous time signal $(t) = cos\ (200\pi t) + \sin\ (320\pi t)$. What will be the Nyquist rate of sampling for the signal? If the signal is sampled at 300samples/sec, write the discrete time signal $x[n]$ obtained after sampling. What will be the frequency components at the output if the sampled signal is passed through an ideal low pass filter with cut off frequency 250Hz? 7

Module -4

17 a) Find the DTFT of the following sequences using properties given $x(n)$ has a DTFT $X(e^{j\omega})$ 7

(i) $x_1(n) = x(1-n)$

(ii) $x_2(n) = e^{j\frac{\pi}{4}n}x(n-2)$

b) Consider an LTI system that is characterized by the difference equation 7

$$y(n) - \frac{3}{4}y(n-1) + \frac{1}{8}y(n-2) = x(n)$$

Find the frequency response $H(e^{j\omega})$ and the impulse response h(n) of the system.

18 a) Find the DTFT of the given signal $x(n)$ 7

$$x[n] = \begin{cases} 1, & |n| \leq N_1 \\ 0, & |n| > N_1 \end{cases}$$

b) State and prove the convolution property of DTFT. 7

Module -5

19 a) Determine the z-transform for the following signal. Sketch the pole-zero plot and indicate the ROC. 7

$$x(n) = \left(\frac{1}{2}\right)^{n-1} u(n+3)$$

b) For the LTI system with system function H(z) find the impulse response so that the system is stable. 7

$$H(z) = \frac{5 - 10z^{-1}}{1 - 3.5z^{-1} + 1.5z^{-2}}$$

Can this system be both stable and causal?

20 a) Find the inverse z-transform of 10

$$X(z) = \frac{2z^2 + 16}{(z+1)(z-2)}$$

for all possible ROCs.

b) Write down any four properties of ROC for Z transform. 4

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