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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S4 (R,S) / S4 (PT) (R,S) / S4 (WP) (R) Examination May 2024 (2019 Scheme)

Course Code: ECT204

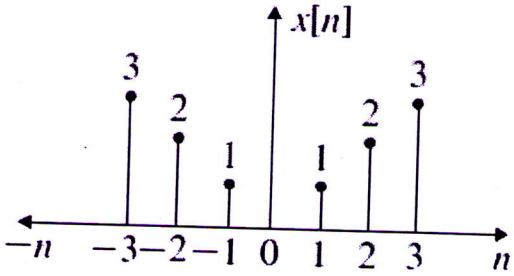
Course Name: SIGNALS AND SYSTEMS

Max. Marks: 100 Duration: 3 Hours

PART A

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

1 For a signal x[n] shown in Fig. sketch $x[3n-1]$ 3



2 A sinusoidal signal with angular frequency 5π $radians/cycle$ is defined by $x[n] = \sqrt{3}\sin(5\pi n)$.Determine the condition under which the sinusoidal signal x(n) is periodic. 3

3 State and prove time-shifting property of Fourier transform. 3

4 Find the Laplace transform of $x(t) = e^{-2t}\,u(t) + e^{3t}\,u(-t)$. Plot the region of convergence (ROC). 3

5 What is the relation between Laplace Transform and Fourier Transform? Explain ROC of right, left and double-sided signal with necessary diagram. 3

6 Determine the Nyquist rate and Nyquist interval for a continues signal x(t) to be sampled $x(t) = \cos(\pi/2)t + 3\sin(2\pi/3)t$ 3

7 Compute the DTFT of $x[n] = \delta[n] - 2\delta[n-10] + 0.5\delta[n+10]$ 3

8 State the Dirichlet's conditions for the convergence of Discrete Time Fourier Transform. 3

9 State any three properties of Z Transform with ROC 3

10 Find the Z Transform and ROC of x[n]= [-1,2,-3,0,4] 3

PART B

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

Module -1

11 a) $x(t)= e^{-|t|}$. Sketch the signal and check whether it is an energy signal or power signal. Also find the energy and power — 7

b) Check whether the following differential equation of a system is linear and time-invariant. $\frac{d\,y(t)}{dt} + 2\,y(t) + 3 = t\,x(t)$ — 7

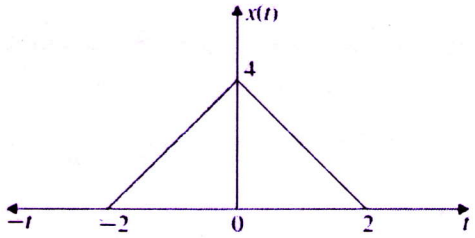
12 a) Find the linear convolution of x(n) = {1, 2, 3, 4, 5, 6} and h(n) = {2, −4, 6, −8} — 6

b) Let the input x[n], to a LTI system is given by $x[n] = \alpha^n\,\{u[n] - u[n-10]\}$ and the impulse response of the system be given by $h[n] = \beta^n\,u[n]$, where $0 < \beta < 1$. Find the output of the system. — 8

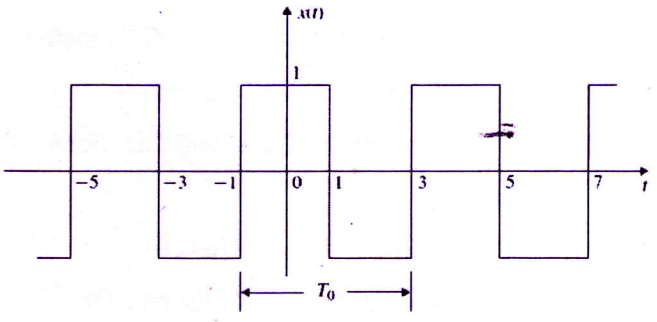
Module -2

13 a) Find the inverse Laplace transform of $X(S) = \frac{-5S-7}{(S-1)(S+1)(S+2)}$ Assuming (i) x(t) is causal (ii) ROC: −1 < Re s < 1 — 7

b) Consider the triangular pulse shown in Fig. Find the FT and sketch their amplitude spectrum. — 7



14 a) Find the trigonometric Fourier series for the periodic signal shown in Fig — 8



b) Find the Fourier series of the following signal. Also, find the power using Fourier series coefficients. $x(t) = 2\cos(3t) + 3\sin(2t)$ — 6

Module -3

15 a) Find the transfer function of LTI system described by the differential equation 7

$\frac{d^2y(t)}{dt^2} + 3\frac{dy(t)}{dt} + 2y(t) = 2\frac{dx(t)}{df} + 3x(t)$.Locate poles and zeros in s-plane and also check whether the given system is stable or not.

b) State and prove sampling theorem for a bandlimited signal. Also explain aliasing and how it is avoided. 7

16 a) Consider an LTI system whose response to the input $x(t) = (e^{-t} + e^{-3t})u(t)$ is $y(t) = (2e^{-t} - 2e^{-4t})u(t)$ Find the system's impulse response and transfer function. 9

b) Find the frequency response of an LTI system having an impulse response 5

$h(t) = \delta(t+2) + 5\delta(t+1) + \delta(t-1) + 5\delta(t-2)$

Module -4

17 a) Define discrete time Fourier transform (DTFT) pair and find the DTFT of x(n)={1,-1,2,2} 4

b) Find the DTFT of the given two discrete time signals 10

(i) $x_1[n] = 1/3^{n-1}\, u[n-1]$

(ii) $x_2[n] = 1/2^n\, u[n] * ¼^n\, u[n]$

18 a) Write the frequency and impulse response of an LTI system described by 8
y[n] = 0.3y[n −1] + 0.1y[n −2] + x[n] + 0.2x[n −1]

b) What are the necessary and sufficient conditions of an impulse response of a discrete system to be causal, stable and both with examples. 6

Module -5

19 a) What do you understand by ROC of z-transform? Mention the properties of ROC. 6

b) Find the ZT of the following discrete-time signals and plot the ROC 8

(i) $x[n] = (\frac{1}{4})^{|n|}$

(ii) $x[n] = 1/2^n\, u[n] * ¼^n\, u[n]$

20 a) find the inverse z-transform $X(z) = \frac{z^{-1}}{3-4z^{-1}+z^{-2}}$; $ROC\ |z| > 1$ 6

b) An LTI system is described by the difference equation 8

$$y[n] - \frac{9}{4}y[n-1] + \frac{1}{2}y[n-2] = x[n] - 3x[n-1]$$

Determine impulse response h[n] for the following conditions

(i) The system is stable (ii) The system is causal

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