Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S4 (S,FE) (FT/WP/PT) Examination December 2025/January 2026 (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		Classify the signal $x(t) = e^{-2t}u(t)$ based on its energy/power nature.	3
2		Plot the signal $x[n] = u[n] - 2u[n-5] + u[n+2]$.	3
3		Compute the Fourier transform of $x(t) = \delta(t) + \delta(t-1)$.	3
4		State and prove the time scaling property of CTFT.	3
5		State the issue of aliasing with the aid of the spectrum of a sampled signal. Explain how it could be avoided.	3
6		State the condition under which the Laplace Transform reduces to Fourier Transform. Explain using the ROC concept.	3
7		State any two properties of DTFT and demonstrate one using a simple signal.	3
8		For a discrete-time signal $x[n] = cos(3\pi n)$, find its DTFS components and plot it.	3
9		Determine the Z-transform and ROC of $x[n] = (0.4)^n u[n]$.	3
10		State the relationship between DTFT and Z-transform.	3

PART B

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

Module -1

11	a)	Check linearity , time invariance, causality and stability of: (i)$y(t) = t \cdot x(t)$ (ii) $y[n] = x[n] + x[n-1]$	8
	b)	The input to an LTI system with impulse response $h[n] = [1,1]$ is $x[n] = [1,2,1]$. Find the output $y[n]$ and plot it.	6
12	a)	Compute the continuous-time convolution between $x(t) = u(t) - u(t-3)$, $h(t) = e^{-2t}u(t)$ and sketch the resulting signal clearly indicating breakpoints.	8
	b)	$x[n] = [1,2,1]$ and $y[n] = [1, 1, 1]$, compute the cross-correlation $Rxy[k]$ and	6

plot it. State the lag k at which the similarity is maximum.

Module -2

13 a) Consider the signal 10

$$x(t) = \begin{cases} 1 & -T/2 \le 0 \le T/2 \\ 0 & Otherwise \end{cases}$$

(i) Derive the Continuous-Time Fourier Transform (CTFT) $X(j\omega)$ of x(t), and sketch $|X(j\omega)|$, clearly indicating the main lobe and the first zero crossings.
(ii) Using the duality property of the Fourier Transform and your result from part (i), deduce the CTFT of the sinc signal,

$$x(t) = \frac{sin\frac{\omega_0 t}{2}}{\frac{\omega_0 t}{2}}$$

b) State and prove the time shifting property of CTFT 4

14 a) Compute Laplace Transform of $(i)\ t\,e^{-2t}u(t)$ $(ii)\ cos\,(3t)\,u(t)$. Plot the ROC of each 8

b) Explain the relationship between Laplace transform and CTFT. 6

Module -3

15 a) Sketch and explain the effects of sampling the signal $\boldsymbol{x(t) = cos\,\pi t}$ at sampling intervals Ts=1/4 s, Ts=3/2 s. 8

b) Consider an LTI system with frequency response $H(\omega) = \frac{1}{4+j\omega}$. For a particular input x(t), the system is observed to produce the output y(t)=$e^{-2t}u(t) - e^{-4t}u(t)$. Find the input x(t). 6

16 a) A system produces an output of $y(t) = e^{-t}u(t)$ for an input of $x(t) = e^{-2t}u(t)$. Determine the impulse response and frequency response of the system. 8

b) A signal is given by $x(t) = 2\cos(400\pi t) + 6\cos(640\pi t)$. What is the minimum sampling frequency required to avoid aliasing? If the signal is ideally sampled with sampling frequency of 500 Hz, what are the frequency components present at the output? 6

Module -4

17 a) Find the DTFT of $x[n] = a^n u[n]$, |a| < 1. Plot the magnitude and phase spectrum. 8

b) Determine frequency response of $y[n] = x[n] - 0.8x[n-2]$. Comment about the values at $\omega = 0, \omega = \pi$. 6

18 a) A periodic signal is given by 8

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

(i) Determine the fundamental period .

(ii) Compute the DTFS coefficients $X[k]$, and sketch the magnitude spectrum.

b) State convolution property of DTFT and verify using sequences $x[n] = \delta[n]$, $h[n] = u[n]$. 6

Module -5

19 a) Find the inverse Z-transform of $\frac{1}{1-0.6z^{-1}}$ for all ROCs. 7

b) Explain the stability and causality of discrete time LTI systems using ROC of Z-transform by giving an example. 7

20 a) Compute and Z-transform and plot the ROC of $x[n] = u[n] - u[n-5]$. 7

b) State and prove any two properties of Z-transform. 7

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