Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S4 (R) (FT/WP) Examinations April 2026 (2024 Scheme)

Course Code: PCECT402
Course Name: SIGNALS AND SYSTEMS

Max. Marks: 60 Duration: 2 hours 30 minutes

PART A

(Answer all questions. Each question carries 3 marks)

		CO	Marks
1	A continuous-time signal x(t) is defined as: $$x(t) = \begin{cases} 1, & -1 \le t < 0 \\ 2, & 0 \le t < 1 \\ 0, & otherwise \end{cases}$$ Sketch and label the following: (i) $x(2 - \frac{1}{2}t)$ (ii) $x(-2t - 1)$	1	(3)
2	Determine whether the following signal is periodic or not. If periodic, determine its fundamental period: (i) $x[n] = e^{j2\pi n/6} + e^{j\pi n/8}$ (ii) $s(t) = cos(2t) + cos(\sqrt{2}\,t)$	1	(3)
3	Find the Fourier series coefficients of the signal $x(t) = sin^2(3\pi t) + \cos(3\pi t)$	3	(3)
4	Establish the relationship between Laplace transform and Fourier transform in both directions.	3	(3)
5	State sampling theorem for low pass signals. Explain it with the help of necessary spectral diagrams for oversampled and undersampled cases.	3	(3)
6	State any three properties of ROC of Z-transform with examples.	3	(3)
7	For an LTI system with impulse response $h(t) = e^{-2(t-1)}u(t-1)$, find the frequency response.	4	(3)
8	The transfer function of an LTI system is given by $H(s) = \frac{(s+2)}{(s-1)(s+3)}$. List all possible ROCs of the system. For which ROC, is the system causal?	4	(3)

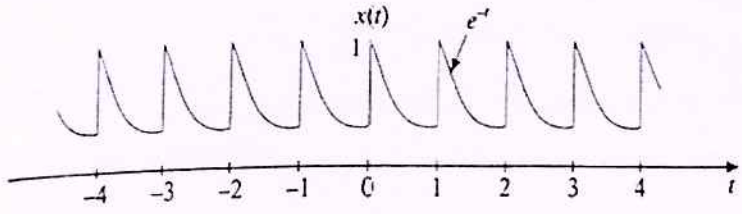
PART B

(Answer any one full question from each module, each question carries 9 marks)

Module -1

9	a)	Find the energy and power of the signal $x(t) = e^t \cos(t)u(t)$. Hence, classify it as an energy signal, power signal, or neither.	1	(3)
	b)	Find the convolution $y(t) = x(t) * h(t)$ and sketch the result where $x(t) = \begin{cases} 2, & 0 < t < 3 \\ 0, & otherwise \end{cases}$ and $h(t) = \begin{cases} 4, & 6 < t < 12 \\ 0, & otherwise \end{cases}$	2	(6)
10	a)	Check whether the system represented by the equation: $$y[n] = x[n^2] + x[n-1]$$ is static or dynamic, linear or non-linear, causal or non-causal, stable or unstable and time-invariant or time-variant	1	(5)
	b)	Find the output of the discrete time LTI system with impulse response $h[n] = (0.5)^n u[n]$ for the input $x[n] = (0.25)^n(u[n] - u[n-4])$.	2	(4)

Module -2

11		Determine the Exponential Fourier series representation of the signal $x(t) = e^{-t}$ with T = 1sec as shown in the figure. Draw its magnitude and phase spectra. 	3	(9)
12	a)	Find the Fourier transform of $x(t) = t^2 e^{-3t}u(t)$	3	(6)
	b)	Find the Laplace transform and ROC of the signal: $x(t) = e^{-2t}u(t) + e^{3t}u(-t)$.	3	(3)

Module -3

13		A signal $m(t) = 6\cos(100\pi t) + 4\cos(500\pi t)$ is ideally sampled at a rate of $f_s = 400\ Hz$. The sampled signal is passed through an ideal low-pass filter of cutoff frequency **160 Hz**.	3	(9)

(i) Check whether aliasing occurs due to sampling.

(ii) Determine the frequencies present in the sampled signal spectrum.

(iii) Find the frequencies present at the output of the filter.

14 a) Find the DTFT of $x[n] = \left(\frac{1}{2}\right)^{n-3} u(n-3) - \left(\frac{1}{3}\right)^{n} u(n)$ 3 (5)

b) Given $X(z) = \frac{z^2}{(z-0.5)(z+0.8)}$ 3 (4)

(i) Determine the Region of Convergence (ROC) such that the DTFT of x[n] exists.

(ii) Hence, obtain the corresponding x[n].

Module -4

15 For an LTI system with transfer function $H(s) = \frac{s^2+3s+2}{(s^2-s-2)(s^2+6s+5)}$, find 4 (9)

the impulse response h(t) if:

(i) System is causal

(ii) System is stable but non-causal

(iii) System is both causal and stable (if possible).

Specify the Region of Convergence (ROC) in each case.

16 Consider an LTI system with transfer function 4 (9)

$H(z) = \frac{1-0.5z^{-1}+z^{-2}}{(1-2z^{-1})(1-0.5z^{-1})}$.

Obtain the impulse response h[n] if:

(i) System is causal

(ii) System is stable but non-causal

(iii) System is causal and stable (if possible).

Specify the Region of Convergence (ROC) for each case.

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