Reg No.:_______________ Name:__________________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

V SEMESTER B.TECH DEGREE EXAMINATION(S), MAY 2019

Course Code: AE307

Course Name: SIGNALS AND SYSTEMS

Max. Marks: 100 Duration: 3 Hours

PART A

Answer any two full questions, each carries 15 marks. Marks

1	a)	Check whether the following signals are periodic. If periodic, find the fundamental time period. (i) $x(t) = \cos(60\pi t) + \sin(50\pi t)$ (ii) $x(n) = e^{j\left(\frac{2\pi}{3}\right)n} + e^{j\left(\frac{3\pi}{4}\right)n}$	(5)
	b)	Determine whether the following signals are energy or power signal. If it is an energy signal, find its energy. If it is a power signal, find its time-averaged power. $$x(t) = \begin{cases} 5\cos(\pi t), & -1 \leq t \leq 1 \\ 0 & otherwise \end{cases}$$	(5)
	c)	Sketch the waveforms of the following signals. (i) $x(t) = u(t+1) - 2u(t) + u(t-1)$ (ii) $y(t) = r(t+2) - r(t+1) - r(t-1) + r(t-2)$	(5)
2	a)	For each of the following impulse responses, determine whether the corresponding system is memory less, causal and stable. (i) $h(t) = \cos(\pi t)u(t)$ (ii) $h(t) = e^{-2t}u(t-1)$ (iii)$h[n] = (-1)^n u[-n]$	(9)
	b)	Determine the homogeneous solution for the systems described by the following equations. (i) $\frac{d^2}{dt^2}y(t) + 6\frac{d}{dt}y(t) + 8y(t) = \frac{d}{dt}x(t)$ (ii) $y[n] + y[n-1] + \frac{1}{4}y[n-2] = x[n] + 2x[n-1]$	(6)
3	a)	Find the discrete time convolution sum of the following signals. (i) $y[n] = \left(\frac{1}{4}\right)^n u[n] * u[n+2]$ (ii) $x(n) = \{2, -1, 1, 3\}$; h(n)={3,4,2}	(15)

PART B

Answer any two full questions, each carries 15 marks.

4	a)	Explain the condition for distortion-less transmission through an LTI system.	(7.5)
	b)	State and explain sampling theorem for band-limited signals and aliasing.	(7.5)
5	a)	State and prove Parseval's theorem for continuous time Fourier series.	(7)

b) Compute the DTFS coefficients of the following signals (8)

(i) $x[n] = \cos(\frac{6\pi}{17}n + \frac{\pi}{3})$ (ii) $x[n] = 2\sin(\frac{14\pi}{19}n) + \cos(\frac{10\pi}{19}n) + 1$

6 a) Find the DTFT of $x(n) = (0.5)^n u(n) + 2^{-n}u(-n-1)$. (5)

b) Find the time domain signal associated with FS coefficients $X(k) = \left(\frac{-1}{3}\right)^{|k|}$; $\omega_0 = 1\, rad/sec$ (5)

c) State and prove time shifting property of CTFT. (5)

PART C

Answer any two full questions, each carries 20 marks.

7 a) Find the bilateral Laplace transform and ROC of the following signals. (10)

(i) $x(t) = e^{at}u(t)$ (ii)$x(t) = e^{5t}u(-t+3)$

b) Find the Z-transform, ROC and pole–zero location of the following signals. (10)

(i) $x(n) = a^{|n|}; \ |a| < 1$ (ii) $\left(\frac{1}{2}\right)^n u[n] + \left(\frac{-1}{3}\right)^n u[n]$

8 a) Using the Laplace transform, find the impulse response of an LTI system described by differential equation $\frac{d^2y(t)}{dt^2} - \frac{dy(t)}{dt} - 2y(t) = x(t)$ (5)

b) Write a short note on how causality and stability of an LTI system are characterized by Laplace transform of its impulse response. (5)

c) (i) Find the Z-transform of the following signal (10)

$$x[n] = ({}^1\!/_2)^n u[n] * 2^n u[-n-1]$$

(ii) Find the time domain signal corresponding to the Z transform.

$$X(z) = \frac{1 + \frac{7}{6}z^{-1}}{(1 - \frac{1}{2}z^{-1})(1 + \frac{1}{3}z^{-1})} \quad , |z| > \frac{1}{2}$$

9 a) Assuming ROC as right half planes, find the inverse Laplace transform of (10)

(i) $X(s) = \frac{s}{s^2 + 5s + 6}$ (ii $X(s) = \frac{5s+4}{s^3+3s^2+2s}$

b) Find the inverse Z-transform of (5)

$$X(z) = \frac{1+\frac{7}{6}z^{-1}}{(1-\frac{1}{2}z^{-1})(1+\frac{1}{3}z^{-1})} \quad \text{, with ROC} \quad 1/3 < |z| < 1/2$$

c) Determine (i) difference equation representation of the system with the following impulse response, and (ii) its transfer function. (5)

$$h(n) = ({}^1\!/_3)^n u[n] + ({}^1\!/_2)^{n-2} u[n-1]$$

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