Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
FOURTH SEMESTER B.TECH DEGREE EXAMINATION(R&S), MAY 2019

Course Code: EC202
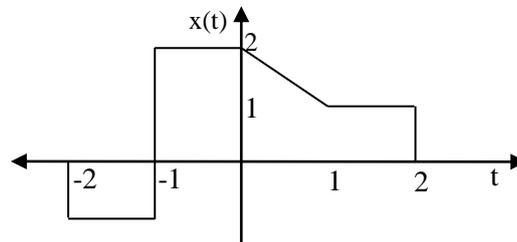**Course Name: SIGNALS & SYSTEMS**

Max. Marks: 100 Duration: 3 Hours

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

1 a) Given the signal *x(t)*. Sketch the signals: (5)

(i) *2x(-2t+3)* and (ii) $y(t) = x(t)\delta(t - 0.5) + x(t)\delta(t + 0.5)$

b) Check whether the following signal is periodic or not. If periodic find the period. (3)

$$x(t) = 3 \sin 200\pi t + 4 \cos 100\pi t$$

c) An LTI system is characterized by the impulse response $h(n) = [1, 2, 1]$. Find the (7)
system response for the given input $x(n) = [3, -1, \ 2, 0, 1]$.

2 a) Determine whether the following signal is energy or power signal and calculate its (4)
energy or power.

$$x(t) = \cos t$$

b) Mathematically analyse the following LTI system for stability and causality. (4)

$$h(n) = a^n u(n), \ |a| < 1$$

c) An LTI system has the impulse response $h(n) = u(n) - u(n - 3)$. Find the (7)
output of the system to the input $x(n) = \left(\frac{1}{3}\right)^n u(n)$.

3 a) Derive the relation between correlation and convolution between two sequences. (5)
Find the cross correlation of two finite length sequences $x(n) = [1, 3, 2, 2]$ and
$y(n) = [1, 2, \ 3, 2]$.

b) Distinguish between causal and non-causal systems with suitable examples. (3)

c) Find the even and odd components of the following signals (7)

1) e^{jt} 2) cost + sint +cost sint

PART B
Answer any two full questions, each carries 15 marks.

4   a)   Derive the relation between Laplace transform and Continuous Time Fourier transform.   (3)

     b)   Evaluate the Fourier Transform of $x(t) = sgn(t)$. Plot magnitude and phase response.   (3)

     c)   An LTI system is characterized with the transfer function $H(s) = \frac{s+5}{s^2+3s+2}$. Find the response of the system to the input $x(t) = \cos 2t\, u(t)$.   (5)

     d)   State Sampling theorem. Compute the Nyquist rate of the signal $x(t)$.   (4)

$$x(t) = \cos\left(\frac{\pi t}{2}\right) - \sin\left(\frac{\pi t}{8}\right) + \cos(\frac{\pi t}{4} + \frac{\pi}{3})$$

5   a)   Determine the Fourier Series Representation for x(t)= 2sin(2πt-3) + sin(6πt).   (6)

     b)   Show that the spectrum of the sampled signal is the infinite sum of shifted replicas of the spectrum of original signal.   (6)

     c)   Evaluate the Fourier Transform of $x(t) = \frac{d(te^{-2t}\sin(t)u(t))}{dt}$.   (3)

6   a)   A causal LTI system has an impulse response $h(t) = e^{-4t}\, u(t)$. Using Fourier transform find,   (7)

       (i) Frequency response of the system.

       (ii) Output of the system for an input $x(t) = 3e^{-t}\, u(t)$.

     b)   State and prove the following properties of Laplace Transform   (4)

          (i) Time domain differentiation

          (ii) Final value theorem

     c)   Find the Inverse Fourier transform of the following signals   (4)

       (i) $\frac{1}{j\Omega(j\Omega+1)} + 2\pi\delta(\Omega)$

       (ii) $2\pi\delta(\Omega) + \pi\delta(\Omega - 4\pi) + \pi\delta(\Omega + 4\pi)$

PART C
Answer any two full questions, each carries 20 marks.

7   a)   Find the Z - transform of $x(n) = 2(3)^n u(-n)$ (5)

     b)   Compute the DTFT of the signal *x(n)*.   (4)

$$x(n) = \begin{cases} 10 & ;|n| \le N \\ 0 & ;|n| > N \end{cases}$$

     c)   Prove that, for a BIBO stable discrete time LTI system the ROC of system function includes unit circle.   (3)

d) An LTI system is described by the following input-output relation (8)

$y(n) - \frac{9}{4}y(n-1) + \frac{1}{2}y(n-2) = x(n) - 3x(n-1)$.

Determine the impulse response of the system with specified ROCs of H(z) for the conditions:

(i) System is stable (ii) System is causal

8 a) Find the discrete time Fourier series coefficients of the signal $x(n) = 5 +$ (6)
$sin\left(\frac{n\pi}{2}\right) + cos\left(\frac{n\pi}{4}\right)$. Plot the magnitude and phase spectrum.

b) Find all possible time domain signals for the Z- transform $X(z) = \frac{1}{1-\frac{1}{6}z^{-1}-\frac{1}{6}z^{-2}}$. (6)

c) A stable and causal LTI system produces an output $y(n) = n\left(\frac{4}{5}\right)^n u(n)$, for the (8)

excitation $x(n) = \left(\frac{4}{5}\right)^n u(n)$. Using Discrete Time Fourier transform,

(i) Determine the Frequency response of the system.

(ii) Derive the difference equation relating the input and output.

9 a) Using Z- transform, determine the output of an LTI system with impulse response (3)
$h(n) = \{1, 2, -1, 0, 3\}$ for the input $x(n) = \{1, 2, -1\}$.

b) Determine the Discrete Time Fourier transform of $x(n) = \left(\frac{1}{2}\right)^n sin\left(\frac{n\pi}{4}\right) u(n)$. (4)

c) Compute the Z-transform and ROC of the signal $x(n) = \left(\frac{1}{2}\right)^n u(-n) - 2^n u(-n-1)$. (8)
Plot the pole-zero pattern.

d) Mathematically explain how DTFT is related with Z- transform. (5)