

Reg No.: _____

Name: _____

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

Course Code: EE307

Course Name: SIGNALS AND SYSTEMS

Max. Marks: 100

Duration: 3 Hours

PART A

Answer all questions, each carries 5 marks.

Marks

- | | | |
|---|--|-----|
| 1 | Define unit ramp function. Plot $r(t)$ and $x(t) = -4r(t)$ | (5) |
| 2 | Find the unilateral Laplace transform and ROC of $x(t) = e^{-t}u(t) + e^{-4t}u(t)$ | (5) |
| 3 | If Fourier transform of $x(t)$ is $X(\omega)$, derive the Fourier transform of $\frac{dx(t)}{dt}$ | (5) |
| 4 | Plot a) $u[n]$ and b) $x[n] = u[n+2] \times u[-n+2]$ | (5) |
| 5 | Consider the sequence $x[n] = a^n$, if $x[n]$ is a causal sequence prove that the ROC of $X(z)$ is the exterior of the circle of radius $ a $, where $X(z)$ is the Z transform of $x[n]$. | (5) |
| 6 | State and prove the linearity and time reversal properties of Z-transform | (5) |
| 7 | Determine whether Fourier series representation is possible for the discrete time signals a) $x[n] = 2\cos\sqrt{5}\pi n$ and b) $x[n] = 4\cos\frac{n\pi}{2}$. If possible find the fundamental period and frequency | (5) |
| 8 | Find the frequency response $H(\omega)$ given, $y[n] = \frac{1}{2}\{x[n] + x[n-2]\}$ | (5) |

PART B

Answer any two full questions, each carries 10 marks.

- | | | |
|----|---|-----|
| 9 | a) Find whether the system $y(t) = at^2x(t) + btx(t-4)$ is a) static b) linear c) causal and d) time invariant | (6) |
| | b) Given $x(t) = e^{-3t}u(t)$. Find the output of the system if the impulse response of the system is given by $h(t) = u(t+3)$ | (4) |
| 10 | a) A $1k\Omega$ resistor is connected in series with $200\mu F$ capacitor. Using Laplace transform find the voltage across the capacitor $y(t)$ if the voltage input is | (6) |

$$x(t) = \frac{3}{5}e^{-2t}u(t) \text{ with the initial condition } y(0) = -2$$

- b) Consider an LTI system described by the differential equation (4)

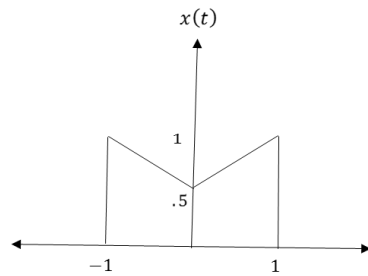
$$\frac{dy(t)}{dt} + 5y(t) = \frac{d^2x(t)}{dt^2} + \frac{dx(t)}{dt} - 2x(t).$$

Find the transfer function of the inverse system and find out whether a stable and causal inverse system exists.

- 11 a) Using bilateral Laplace transform find the ROC of the signal $x(t) = e^{-b|t|}$ for a) (6)

b) $b > 0$ and b) $b < 0$

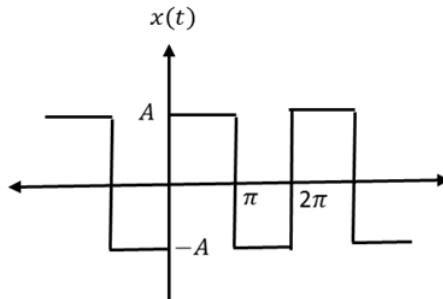
- b) For $x(t)$ given below, plot $x(-2t - 1)$ (4)



PART C

Answer any two full questions, each carries 10 marks.

- 12 a) Find the exponential Fourier series and plot the magnitude and phase spectrum of (10)
the following waveform.



- 13 a) Define sampling theorem. With the help of frequency spectrum explain signal (6)
reconstruction is possible only if sampling frequency is $f_s \geq 2f_m$

- b) Using Fourier transform property find the Fourier transform of (4)

$$x(t) = e^{-3t}u(t-2)$$

- 14 a) Using graphical method find the convolution of $x[n] = \{1, 3, 3, 2\}$ and (6)

$$h[n] = u[n] - u[n-4]$$

- b) The impulse response of a system is given by $h[n] = 3^n u[-n]$. Find whether the system is causal, stable and dynamic (4)

PART D

Answer any two full questions, each carries 10 marks.

- 15 a) Determine the causal signal $x[n]$, if the Z-transform of the signal is given by (6)

$$X(z) = \frac{1}{(1+z^{-1})(1+z^{-1})^2}$$

- b) An LTI system has the impulse response $h[n] = \left(\frac{1}{2}\right)^n u[n]$. Determine the input of the system if the output is $y[n] = \left(\frac{1}{2}\right)^n u[n] + \left(\frac{-1}{2}\right)^n u[n]$ (4)
- 16 a) Find the Z-transform and ROC of $x[n] = n \left(\frac{-1}{2}\right)^n u[n] * \left(\frac{1}{4}\right)^{-n} u[-n]$. Symbol * represents convolution (6)
- b) If a discrete time periodic signal has periodicity N, write its Fourier series representation. Write down any three differences between continuous time and discrete time Fourier series (4)
- 17 The impulse response of a discrete time system is given by (10)
- $$h[n] = \frac{1}{2} \delta[n] + \delta[n-1] + \frac{1}{2} \delta[n-2].$$
- Find the system frequency response $H(\omega)$ and plot the magnitude and frequency spectra
