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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 carries5 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 $X(w)$, 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 $a)\ x[n] = 2cos\sqrt{5}\pi n$ *and* $b)\ x[n] = 4cos\frac{n\pi}{2}$. If possible find the fundamental period and frequency (5)

8 Find the frequency response $H(w)$ given, $y[n] = \frac{1}{2}\{x[n] + x[n-2]\}$ (5)

PART B

Answer any two full questions, each carries10 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)

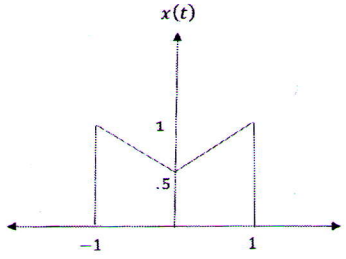
10 a) A $1k\Omega$ resistor is connected in series with $200\mu F$ capacitor. Using Laplace transform find the voltage across the capacitor $y(t)$ if the voltage input is (6)

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

b) Consider and 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) b>0 and b) b<0 (6)

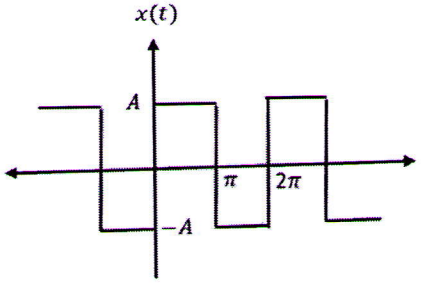
b) For $x(t)$ given below, plot $x(-2t-1)$ (4)



PART C

Answer any two full questions, each carries10 marks.

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



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

b) Using Fourier transform property find the Fourier transform of $x(t) = e^{-3t}u(t-2)$ (4)

14 a) Using graphical method find the convolution of $x[n] = \{1,3,3,2\}$ and $h[n] = u[n] - u[n-4]$ (6)

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)

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

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 $h[n] = \frac{1}{2}\delta[n] + \delta[n-1] + \frac{1}{2}\delta[n-2]$. Find the system frequency response $H(w)$ and plot the magnitude and frequency spectra (10)

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