Reg No.:_______________ Name:__________________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B.TECH DEGREE EXAMINATION, APRIL 2018

Course Code: AE307

Course Name: SIGNALS AND SYSTEMS (AE)

Max. Marks: 100 Duration: 3 Hours

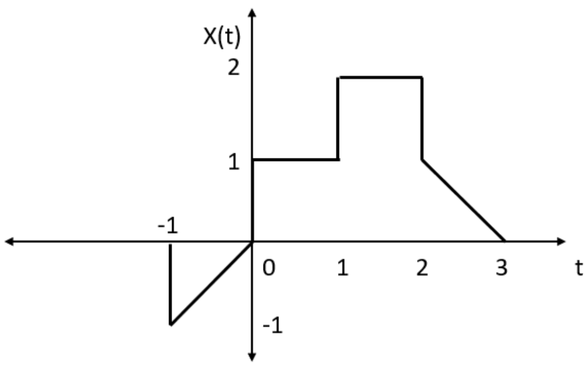
PART A

Answer any two full questions, each carries 15 marks

Marks

1 a) Differentiate between energy and power signals. Give an example for each category. (4)

b) A continuous time signal x(t) is shown below. Sketch and label each of the following signals: (6)



i) $x(1-t)$ ii) $x(2t+1)$ iii) $x(t)[u(t)-u(t-2)]$

c) Determine whether the following signals are periodic. If the signal is periodic determine its fundamental period. (5)

i) $x[n] = 2\cos\left(\frac{\pi}{4}n\right) + \sin\left(\frac{\pi}{8}n\right) - 2\cos\left(\frac{\pi}{2}n + \frac{\pi}{6}\right)$

ii) $x(t) = sin^2(\frac{3}{2}\pi t) + \cos(4\pi t)$

2 a) Find the natural response of the system described by the difference equation $y(n) - 1.5y(n-1) + 0.5y(n-2) = x(n)$. Given $y(-1) = 1$ and $y(-2) = 0$. (7)

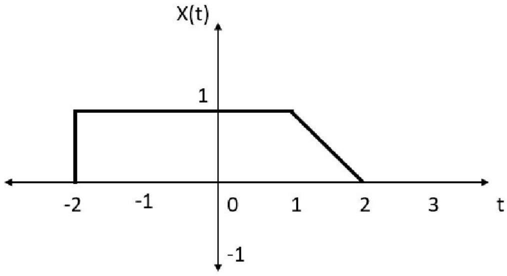
b) Check the causality and stability of the systems whose impulse response are given below: (4)

i) $h(t) = e^{at}u(t)$; $a < 0$ ii) $h[n] = 2^n u[-n]$

c) Find the output sequence of an LTI system with impulse response$h[n] = \{2, 4, 1\}$to the input sequence$x[n] = \{1, 2, 3, 4\}$. (4)

3 a) Let x(t) be the input to an LTI system with unit impulse function h(t), where,$x(t) = e^{-at}u(t)$; $a > 0$ *and* $h(t) = u(t) - u(t-T)$. Find the system response y(t). (7)

b) Determine the even and odd components of the following signal. (4)



c) Determine which of the properties (Memoryless, Time-invariant, linear and causal) hold andwhich do not hold for the continuous-time systemdescribed by$y(t) = x(t-2) + x(2-t)$. Justify your answer. (4)

PART B

Answer any two full questions, each carries 15 marks

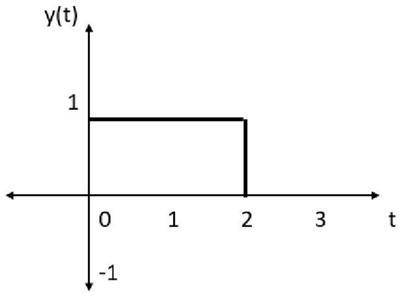
4 a) Compute the auto correlation of the signal $x[n] = a^n u[n]\ ; 0 < a < 1$ (7)

b) State and prove sampling theorem for low pass signals. (8)

5 a) Explain the Dirichlet conditions for the existence of Fourier series of a continuous-time periodic signal. (2)

b) Find the Fourier series coefficients of the signal $x(t) = |\cos(t)|$. Plot the spectrum and hence find the amplitude of the dc component of x(t). (5)

c) Given $x(t) = \begin{cases} 1 & ; \quad |t| \le 1 \\ 0 & ; \quad Otherwise \end{cases}$. Compute the Fourier transform $X(\omega)$ for the given signal x(t). Plot the magnitude and phase spectrum. Use this Fourier transform pair $x(t) \leftrightarrow X(\omega)$, to compute the Fourier transform of the following signal using appropriate property. (8)



6 a) Explain and write the conditions for distortion-less transmission through an LTI transmission system. (5)

b) Determine the Nyquist sampling rate for the following signal: (3)
$x(t) = 2Sin250\pi t + 3cos^2 500\pi t.$

c) State and prove Discrete Time Fourier Transform convolution theorem. Use this theorem to solve $y[n] = x_1[n] * x_2[n]$. (7)
Given $x_1[n] = \left(\frac{1}{2}\right)^n u[n]$and $x_2[n] = \left(\frac{1}{3}\right)^n u[n]$.

PART C

Answer any two full questions, each carries 20 marks

7 a) Determine the Laplace transform and the associated region of convergence (ROC) and pole zero plot for each of the following functions: (8)

i) $x(t) = e^{-2t}u(t) + e^{-3t}u(t)$ ii) $x(t) = te^{-3|t|}$

b) Consider a continuous-time LTI system for which the input x(t) and output y(t) are related by the differential equation $\frac{d^2y(t)}{dt^2} - \frac{dy(t)}{dt} - 2y(t) = x(t)$. Plot the pole zero plot of H(s). Determine the impulse response, h(t) if the system is causal. (6)

c) State and prove initial value theorem and final value theorem. (6)

8 a) Find the z transform and specify the ROC of the following: (10)

i) $x[n] = n\left(-\frac{1}{4}\right)^n u[n] * \left(\frac{1}{6}\right)^{-n} u[-n]$

ii) $x[n] = \left(\frac{1}{5}\right)^n u[n] + \left(\frac{1}{4}\right)^n u[-n-1]$

b) Using power series expansion method, find the inverse z transform of $X[Z] = \frac{4z}{(z^2-3z+2)}$ ROC: |z| > 2 (5)

c) Find the impulse response of the discrete-time system described by the difference equation, $y[n-2] - 3y[n-1] + 2y[n] = x[n-1]$. (5)

9 a) Find the inverse Laplace transform of the following: (10)

i) $X(s) = \frac{(s+1)+3e^{-4s}}{(s+2)(s+3)}$ ii) $X(s) = \frac{10(s+4)}{s^2(s+2)}$

b) An LTI system is characterized by the system function $H(z) = \frac{3-4z^{-1}}{1-3.5z^{-1}+1.5z^{-2}}$ (10)
Specify ROC and find the impulse response, h[n] for the following conditions:
i)System is stable ii) System is causal iii) System is anti-causal.

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