Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Fifth Semester B.Tech Degree Examination (Regular and Supplementary), December 2020

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) Find the even and odd components of the signal (4)

(i)x(t) = e^{j10t} $(ii)\ x(n) = \{-2,1,2-1,3\}$, where $x(0) = 2$

b) Sketch the signal $(i)\ r(t) - 2r(t-1) + r(t-2)$ (4)

(ii)y(t) = u(t+3) u(-t+3)

c) Check the systems (i) $y(t) = t^2 x(t)$ (7)

(ii) y[n] = nx[n] for linearity and time invariance.

2 a) Derive the stability criterion for linear time invariant (LTI) system in terms of impulse response. (5)

b) Given a discrete time LTI system whose impulse response is $h[n] = n(\frac{1}{2})^n u[n]$. Test the stability and causality of the system. (5)

c) Derive the expression for convolution integral for an LTI system. (5)

3 a) Impulse response of a DT-LTI system is given as $h[n] = \{1 \underset{\uparrow}{} 3\ 2\ 1\}$. Find the response y[n] of the system corresponding to an input $x[n] = \{1\ \underset{\uparrow}{4}\ 3\ 2\}$ (5)

b) Analyse the following signals to determine whether it is energy signal, power signal or neither. Justify your answer with relevant results and equations. (10)

(i) $x(t) = \begin{cases} t, & 0 \le t \le 1 \\ 2-t, & 1 \le t \le 2 \\ 0, & otherwise \end{cases}$

(ii) $x(t) = t\,u(t)$

PART B

Answer any two full questions, each carries 15 marks.

4 a) Derive the expression for impulse response of an ideal low pass filter and plot the frequency response. (6)

b) Obtain the response y(t) from an ideal low pass filter if a rectangular pulse x(t) is transmitted through it, where $x(t) = \begin{cases} 1, & |t| \leq \left(\frac{T_0}{2}\right) \\ 0, & otherwise \end{cases}$ (9)

5 a) State and prove the Parseval's relation and convolution property of Discrete time Fourier series. (8)

b) Obtain the Fourier transform of the signal x(t) = te^{-2t} u(t) using an appropriate property. (3)

c) Find the Continuous Time Fourier Series coefficients of the signal x(t) = cos4t + sin6t. (4)

6 a) Give the conditions for distortionless transmission through an LTI systems (6)

b) Find the discrete time Fourier transform of the signal x[n] = $-a^n$u[-n-1], if a is real and $|a| < 1$. (5)

c) A DT- LTI system is represented by $H(e^{j\omega}) = \frac{1}{1+\frac{1}{2}e^{-j\omega}-\frac{1}{8}e^{-j2\omega}}$ (4)

Find the difference equation representing the input-output relation of the system.

PART C

Answer any two full questions, each carries 20 marks.

7 a) A causal DT-LTI system is described by $y[n] - \frac{5}{6}y[n-1] + \frac{1}{6}y[n-2] = x[n]$, where x[n] and y[n] are input and output of the system. Determine the system function H(z), impulse response and step response . (12)

b) Check whether the system described in 7a. is stable. Also find the response corresponding to an input $x[n] = (\frac{1}{4})^n$ u[n]. (6)

c) Derive the relation between Z-Transform and Fourier transform (2)

8 a) Given $X(s) = \frac{s+1}{s^2+3s+4}$, find the Laplace transform using the properties of Laplace transform .(i) $y_1(t) = x(2t)$ (ii)$y_2(t) = e^{-2t}$ x(t) (iii) $y_3(t)=x(t)*x(t)$ (12)

b) Find the initial and final values of the signal with Laplace transform (4)

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

c) Find the Laplace transform and plot ROC of the signal x(t) = cosΩ_0t u(t) (4)

9 a) Find the inverse Laplace transform of $X(s) = \frac{2s+4}{s^2+4s+3}$ for the following 3 ROCs (i) Re(s) > -1 (ii) Re(s) < -3 (iii) -3 < Re(s) < -1. (12)

b) Give the properties of ROC of Z-Transform (8)

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