Reg. No._____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FOURTH SEMESTER B.TECH DEGREE EXAMINATION, MAY 2017

Course Code: EC202

Course Name: SIGNALS & SYSTEMS

Max. Marks: 100 Duration: 3 Hours

PART A

Question No. 3 is compulsory.

1. a) Plot the signal $x(t) = u(t+1) + 2u(t) - u(t-3) - 2u(t-5)$ **(4)**

   b) Check the periodicity of given signals. Find the fundamental period if periodic

   i) $x(t) = 10\sin 25\pi t + \cos 10\pi t$

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

   c) Determine whether the following system is time invarient, linear and causal.

   $y(n) = x(n) + \frac{1}{x(n-1)}$ **(5)**

   d) Evaluate the following integral $\int_{-10}^{10} \cos(\pi t)\delta(2t-10)dt$ **(2)**

OR

2. a) What is the output sequence of a LTI system with impulse response h(n)=[3 , 2] to the input x(n)=[1, 2,3, 3]? **(5)**

   b) Compute the auto correlation of the signal $x(n)=a^{n}u(n)$ for $0<a<1$ **(6)**

   c) Check the causality and stability of the systems whose impulse responses are given

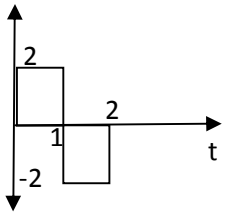
   i) $h(t) = e^{at}u(t)$ ii) $h(n) = 2^{n}u(-n)$ **(4)**

   (a < 0)

3. a) Find the output of an LTI system whose impulse response is **h(t)** to the input **x(t).**

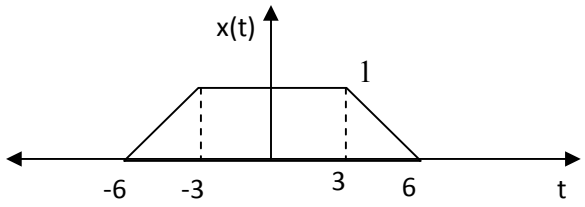
   $h(t) = u(t) - u(t-1)$

x(t)=



(8)

b) For the given signal, plot *x(3-3t)*



(3)

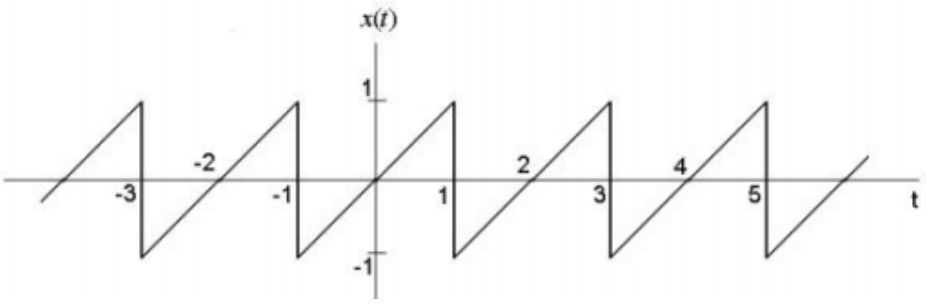
c) Classify the following signals into energy, power or neither. Determine energy and power.

i) $e^{2t}u(-t)$ ii) $e^{-3|t|}$ **(4)**

PART B

Question No. 6 is compulsory.

4. a) Determine the Fourier series representation of the signal shown in figure.



(8)

b) Compute and sketch the magnitude and phase spectrum of the signals

i) $x(t) = Ae^{-a|t|}$ (a>0) **(4)**

ii) $x(t) = \cos^2(2\pi t + 5) + 2\sin(5\pi t)$ **(3)**

OR

5. a) The step response of an LTI system is by $(1 - e^{-t} - te^{-t})u(t)$. For an input $x(t)$, the output is observed to be $(2 - 3e^{-t} + e^{-3t})u(t)$. For this observed measurement, determine the input to the system using laplace transform. **(6)**

b) State the sampling theorem for low pass signals **(2)**

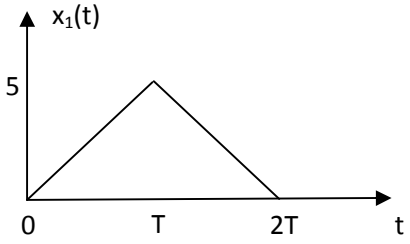
c) Determine the Nyquist rate of sampling for the signals

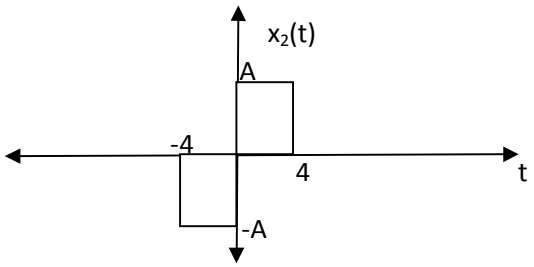
i) $x(t) = 2\sin 250\pi t + 3\cos^2 500t$ **(2)**

ii) $x(t) = 10 \text{ sinc } 500t$ **(3)**

d) A signal $x(t) = 2\cos 400\pi t + 6\cos 600\pi t$ is sampled with a sampling frequency 800Hz. Write the resultant discrete time signal. **(2)**

6. a) Find the Fourier Transform of following signals $x_1(t)$ and $x_2(t)$ (Any relevant property can be applied) **(10)**





b) A continuous time LTI system is described by the differential equation

$$\frac{d}{dt}y(t) + 5y(t) = x(t)$$

Determine the response of the system to the input $x(t) = e^{-2t}u(t)$ using Fourier Transform. **(5)**

PART C

Question 9 is compulsory.

7. a) Evaluate the inverse Z-transform of

$X(z) = \log \frac{1}{1-az^{-1}}$ $\quad |a|<|z|$ **(4)**

b) Evaluate the DTFT of following signals

i) $x(n) = a^n \sin \Omega_0 \, nu(n)$ **(4)**

ii) $x(n) = 0.25^n\, u(n+2)$ **(4)**

c) Give the Parseval's theorem for DTFT. Prove it. **(4)**

d) Compute the energy of the sequence $x(n) = \frac{\sin \Omega_c n}{\pi n}$ **(4)**

OR

8. a) A system is described by the difference equation

$$y(n) = x(n) - x(n-1) - \frac{1}{4}y(n-1) + \frac{1}{8}y(n-2)$$

Determine the impulse response of the system using fourier transform. Also find the step response of the system. **(8)**

b) An LTI system is characterized by the system function given as

$$H(z) = \frac{3 - 4z^{-1}}{1 - 3.5z^{-1} + 1.5z^{-2}}$$

Under what conditions the system will be obey causality and stability? **(4)**

Determine the impulse response of the system such that

i) The system is causal ii) The system is stable

Justify the answers. **(8)**

9. a) The frequency response of a three point moving average system is given as $H(e^{j\Omega}) = \frac{1}{4}(1 + \cos \Omega)\, e^{-j\Omega}$. Determine the difference equation representation of the system. **(5)**

b) Determine the response of the system with impulse response $h(n) = (0.5)^n\, u(n)$ to the input signal $x(n) = 10 - 5 \sin \frac{\pi}{2} n$ **(5)**

c) Find the z-transform and specify ROC

i) $x(n) = u(n-2) * (\frac{2}{3})^n u(n)$ *(* stands for convolution)* **(5)**

ii) $x(n) = -n(\frac{1}{3})^n u(-n-1)$ **(5)**

***

Total Pages: 2

Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FOURTH SEMESTER B.TECH DEGREE EXAMINATION, JULY 2017

Course Code: EC202

Course Name: SIGNALS & SYSTEMS

Max. Marks: 100 Duration: 3 Hours

PART A

Question No. 3 is compulsory. Answer question 1 or 2

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

b) A system has input - output relation given by $y[n] = nx[n]$. Determine whether the system is memoryless, causal, linear, time invariant or stable. (5)

c) A signal is given by $x(t) = \begin{cases} 1 & -1 \le t \le 1 \\ 0 & otherwise \end{cases}$ (6)

Sketch $x(3t+2), x(2(t-2))$ and $x(-2t-1)$.

OR

2 a) Derive the condition for stability of a discrete time LTI system in terms of its impulse response. (4)

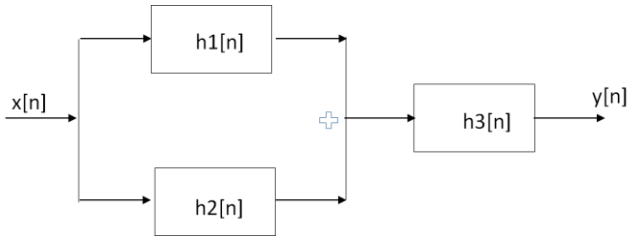
b) Given $x_1[n] = \{1,1,1\}$ and $x_2[n] = \{1,2\}$. Find convolution of the sequences graphically. (5)

c) For an LTI system, unit impulse response is given by $h(t) = e^{-at}u(t),\ a > 0$. Obtain step response of the system. (6)

3 a) What are the three differences between discrete time sinusoids and continuous time sinusoids? Find the fundamental period of $x[n] = \cos \Pi n$, if periodic. (4)

b) An LTI system is described by $y[n] - \frac{1}{2}y[n-1] = x[n]$. Assuming initial conditions as zero, find its impulse response (5)

c) (6)



Given $h1[n] = u[n],\ h2[n] = u[n+2] - u[n]$ and $h3[n] = \delta[n-2]$. Find the overall impulse response of the given system.

PART B

Question No. 6 is compulsory. Answer question 4 or 5

4 a) Explain Dirichlets conditions for the existence of Fourier Transform of a continuous time signal. (4)

b) Determine the complex exponential Fourier Series representation of the signal, $x(t) = \cos 4t + \sin 6t$. (5)

c) Find Fourier Transform of signal $x(t) = te^{at}u(t)$. (6)

OR

5 a) State and prove sampling theorem for low pass signals. (4)

b) A continuous time LTI system is described by $\frac{dy(t)}{dt} + 2y(t) = x(t)$. Using Fourier transform, find the output y(t) given $x(t) = e^{-t}u(t)$. (5)

c) A signal is given by $x(t) = 2Cos(400\pi t) + 6Cos(640\pi t)$ What is the minimum sampling frequency required to avoid aliasing? If the signal is ideally sampled with sampling frequency of 500 Hz, what are the frequency components present at the output? (6)

6 a) State and prove time-shifting property of Laplace transform. (4)

b) Find inverse Laplace transform of $X(s) = \frac{-5s-7}{(s+1)(s-1)(s+2)}$, with ROC $-1 < \mathrm{Re}(s) < 1$ (5)

c) For a continuous time LTI system, input $x(t)$ and $y(t)$ are related by $\frac{d^2y(t)}{dt^2} + \frac{dy(t)}{dt} - 2y(t) = x(t)$. Find system function *H(s)*. Determine *h(t)* given that the system is causal. (6)

PART C

Question 9 is compulsory. Answer question 7 or 8

7 a) Write down properties of ROC for Z transform (6)

b) x[n] is a discrete time periodic square wave with period N and amplitude 1. Non-zero samples extends from $-N_1$ to $+N_1$. Find the Fourier coefficients. (7)

c) Find inverse z-transform of X(z) using power series expansion technique. (7)

$$X(z) = \frac{z}{2z^2 - 3z + 1} \quad |z| > 1$$

OR

8 a) Determine the discrete Fourier series representation for the sequence $x[n] = \cos\frac{\pi}{4}n$ and pot the magnitude and phase response. (6)

b) A discrete time LTI system is given by $y[n] - \frac{1}{2}y[n-1] = x[n] + x[n-1]$. Determine frequency response and impulse response of the system. (7)

c) Explain the relation between DTFT and z-transform. Explain whether DTFT can be obtained from z-transform for (i) $x[n] = a^n u[n]$ (ii) $x[n] = u[n]$ (7)

9 a) State and prove convolution property of DTFT. (6)

b) Given $x[n] = \begin{cases} 1, & |n| \le N_1 \\ 0, & |n| > N_1 \end{cases}$ Find Fourier Transform (7)

c) The step response of a discrete time LTI system is given by $s[n] = a^n u[n]$; $0 < a < 1$, Find impulse response *h[n]* of the system using z-transform. (7)

****

Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FOURTH SEMESTER B.TECH DEGREE EXAMINATION, APRIL 2018

Course Code: EC202

Course Name: SIGNALS & SYSTEMS

Max. Marks: 100 Duration: 3 Hours

PART A

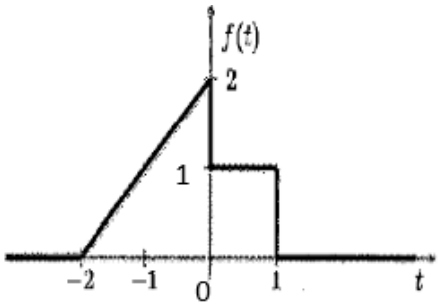
Answer any two questions, each carries 15 marks Marks

1 a) Determine whether the signal $x[n] = 1 + \sin\left(\frac{5\pi n}{3} + \frac{\pi}{2}\right)$ is periodic. Find the fundamental period if it is periodic. (2)

b) For the signal *f(t)* shown below: (7)

i) Sketch *f(3-2t)*

ii) Find the energy of the signal *f(t).*



c) Check whether the following systems are linear and stable. (6)

(i) $y(t) = e^{x(t)}$

(ii) $y[n] = x[n-1]$

2 a) Let $f(t) = 2(u(t) - u(t-2))$ and $g(t) = e^{t}(u(t) - u(t-2))$

(i) Sketch the functions *f(t)* and *g(t)* (2)

(ii) Compute *f(t)*g(t).* Here * denotes convolution. (7)

b) Define the cross correlation function $\Phi_{xy}(\tau)$ for two signals $x(t)$ and $y(t)$. What is its connection with convolution? (2)

c) Consider an LTI system with impulse response $h[n] = u[n]$. Determine the stability and causality of this system. (4)

3 a) Find the convolution of a signal $x[n] = \{1, -1, 1, -1\}$ with itself. (6)

↑

b) Check whether the system described by the input output relationship $y[n] = x^2[n]$ is time invariant. (3)

c) Determine the power and energy of the following signals. Classify them as energy/power signals. (6)

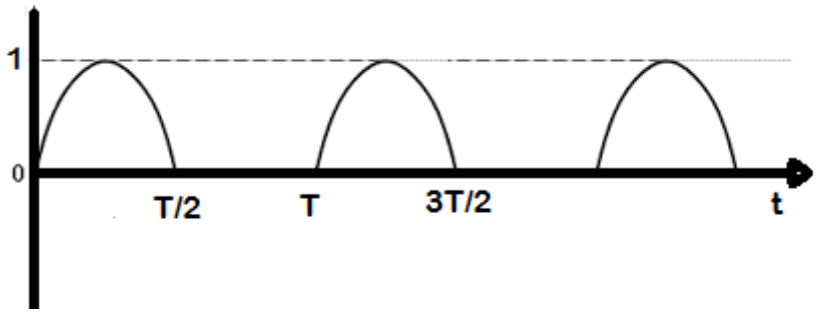
(i) $x(t) = A\sin(\Omega t)$

(ii) $x[n] = u[n]$

PART B

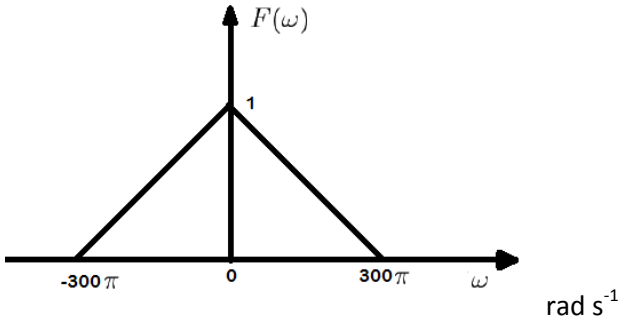
Answer any two questions, each carries 15 marks

4 a) Determine the exponential Fourier series representation of half wave rectified sine wave as shown in the figure below. (10)



b) State and prove the Parseval's theorem for continuous time Fourier transforms. (5)

5 a) Let f(t) be a signal with the spectrum as shown below.



(2)

(i) What is the Nyquist frequency (in Hz) of the signal f(t)? (6)

(ii) Suppose the signal is sampled by an impulse train $\delta_{Fs}(t) = \sum_{k=-\infty}^{\infty} \delta(t - kT)$ where T is the sampling period and Fs is the sampling frequency. Sketch the spectrum of the sampled signals with (A) Fs = 200 Hz and (B) Fs=400 Hz. (1)

(iii) Specify whether the original signal can be recovered from samples in each case (Fs=200 Hz and Fs=400 Hz).

b) An LTI system has $h(t)$ such that $\mathcal{L}\{h(t)\} = H(s) = \frac{1}{s+1}$, $Re\{s\} > -1$. Determine the system output y(t) if the input is x(t) = $(e^{-t/2} + 2e^{-t/3})\, u(t)$. (6)

6 a) Find the Laplace transform and ROC of the following signals. (9)

(i) $e^{-a|t|}, a > 0$

(ii) $\sin(\omega_0 t + b)e^{-at}u(t)$ a, b *real numbers*

b) Let $\mathbf{F}(\omega) = \mathcal{F}\{f(t)\}$. Determine the Fourier transform of $g(t) = f(at - b)$ in terms of $F(\omega)$ where $a \neq 0$, a, b *real*. Handle the cases for $a > 0$ *and* $a < 0$ separately. (6)

PART C

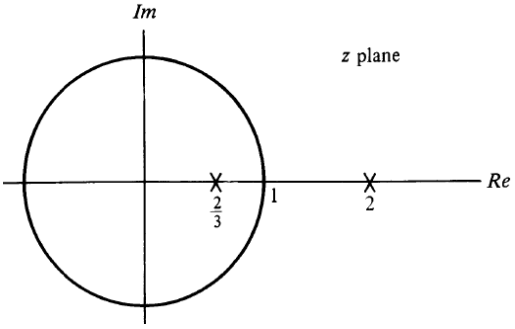
Answer any two questions, each carries 20 marks

7 a) Find the Z transform and ROC of the following signals. (5)

(i) $x[n] = 2^n u[n]$

(ii) $\delta[n]$

b) Pole zero plot for Z transform X(z) of a discrete time signal x[n] shown below. (6)



Determine the ROC in each of the following cases.

(i) x[n] is right sided

(ii) Fourier transform of x[n] converges

(iii)x[n] is left sided

c) Determine the DTFS coefficients for the discrete time signal (9)

$x[n]=\cos(\frac{2\pi n}{3})+ \sin(\frac{2\pi n}{7})$

Also plot the magnitude and phase spectra.

8 a) Consider a LTI system characterised by input output relationship

$$y[n] - \frac{1}{4}y[n-1] = x[n] + \frac{1}{6}x[n-1]$$ (2)

(i) Compute the system function H(z). (2)

(ii) Sketch the possible ROCs for H(z).

(iii)Compute the impulse response h[n] if it is known that impulse response is left sided. (4)

b) Consider a system with impulse response $h[n] = (0.5)^n u[n]$.

(i) Determine the system function $H(e^{j\omega})$ (4)

(ii) If the input $x[n] = \cos(\frac{n\pi}{2})$, determine the output y[n]. (8)

9 a) List any four properties of Z-transform, state and prove the convolution property of Z transforms. (10)

c) A signal $x(n)$ has DTFT $X(e^{j\omega}) = \frac{1}{1-ae^{-j\omega}}$, |a|<1. Determine the DTFT of $x[n+2]\ e^{j\frac{\pi}{2}n}$. (4)

d) Determine the DTFT of the signal x[n]=u[n]-u[n-N] (6)

****

Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FOURTH SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2018

Course Code: EC202

Course Name: SIGNALS & SYSTEMS

Max. Marks: 100 Duration: 3 Hours

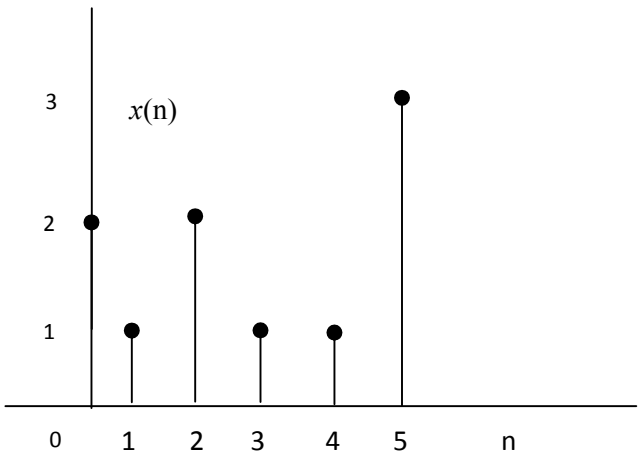
PART A

Answer any two questions

1 a) Observe the given signal and sketch the following: 2x3=6

(i) $y(n) = 2x(-2n + 1)$

(ii) $z(n) = -x\left(\frac{n}{2} - 2\right)$



b) Compute the power and energy of the following signals and check whether they are power signals or energy signals 2x3=6

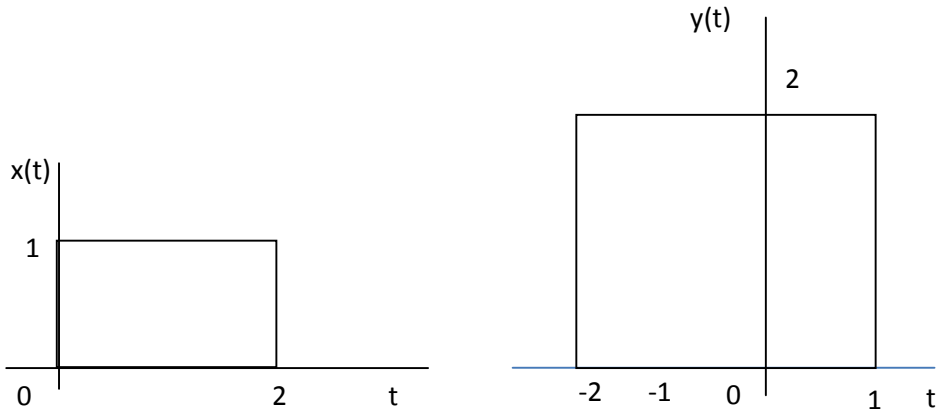
(i) $x(n) = \left(\frac{1}{3}\right)^n u(n)$

$(ii)\ y(t) = (1 + e^{-5t})u(t)$

c) Define, sketch and list the properties of continuous time impulse function. 3

OR

2 a) Find the convolution of the given signals and sketch the result: 9



b) Find the convolution of the following sequences using matrix multiplication method 6

$x(n) = \{1, -2, 3, 1\}$ $\quad\quad$ $y(n) = \{2, -3, -2\}$

3 a) Show that any signal can be represented as the summation of an odd and an even signal. Write down the expression for the odd and even components of the signals $x(t)$ *and* $x(n)$. Find the odd and even components of the signal $x(n) = \{-2, 1, 2, -1, 3\}$ 7

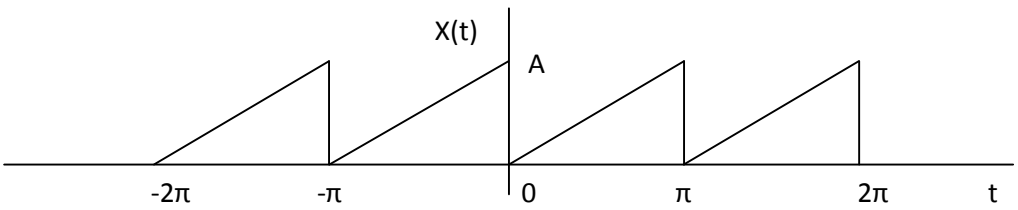
b) Find the convolution of the following signals and plot the result: 8

$$x(n) = \left(\frac{1}{3}\right)^{-n} u(-n-1) \qquad h(n) = u(n-1)$$

PART B

Answer any two questions

4 a) Obtain the fourier series representation of the given waveform. Plot magnitude spectrum. 8



b) Find the CTFT of the signal $x(t) = te^{-at}u(t)$ using an appropriate property. State and prove the property used. 7

5 a) Find the response of a system with transfer function $H(s) = \frac{1}{(s+1)(s+0.5)}$ for unit step input. 5

b) A causal LTI system is described by the relation 6

$$\frac{d^2y(t)}{dt^2} + 6\frac{dy(t)}{dt} + 8y(t) = 2x(t)$$

Find the impulse response of the system applying Fourier Transform

c) Obtain the transfer function of an ideal integrator in s domain. 4

6 a) Find the inverse Laplace transform of the following function: 5

$$X(s) = \frac{3s^2 + 8s + 6}{(s+2)(s^2+2s+1)}, Re(s) > -1$$

b) Find the Fourier transform of unit step function 5

c) State and prove Parseval's theorem for Fourier series. 5

PART C

Answer any two questions

7 a) Show that Fourier transformof the signal 8

$$x(n) = sin\left(\frac{\pi n}{2}\right)u(n)$$

is given by $X(e^{j\omega}) = \frac{e^{-j\omega}}{1+e^{-j2\omega}}$

b) Find the z-transform and ROC of the following signals:

(i) $x(n) = a^{|n|}$; $|a| < 1$ 3

(ii) $y(n) = \frac{1}{2}n^2\left(\frac{1}{3}\right)^{n-1}$u(n-1) 5

c) Prove that convolution in time domain is equivalent to multiplication in Z domain 4

8 a) Determine the impulse response of the following system using Fourier Transform method:$y(n) - \frac{1}{6}y(n-1) - \frac{1}{6}y(n-2) = x(n)$ 8

b) Plot the pole-zero diagram and asses the stability of the following system: 8

$y(n) = y(n-1) - 0.5y(n-2) + x(n) + x(n-1)$

c) Find the DTFT of the signal if z-transform is given by 4

$$X(z) = \frac{z}{(z-0.2)(z+0.9)}$$

9 a) A discrete time LTI system is characterised by the impulse response $h(n) = \left(\frac{1}{2}\right)^n u(n)$ Use Fourier transform to determine the response of the system to the input $x(n) = \left(\frac{3}{4}\right)^n u(n)$ 8

b) Determine the z-transform and plot the ROC of the signal starting from definition of z-transform 8

$$x(n) = a^n u(n) - b^n u(-n-1)$$

c) Establish the correspondence between s-plane and z-plane 4

***

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

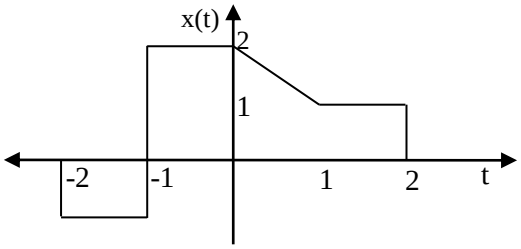
Max. Marks: 100 Duration: 3 Hours

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 system response for the given input $x(n) = [3, -1, \underset{\uparrow}{2}, 0, 1]$. (7)

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

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

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 output of the system to the input $x(n) = \left(\frac{1}{3}\right)^n u(n)$. (7)

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 $y(n) = [1, 2, \underset{\uparrow}{3}, 2]$.

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 $x(t) = \text{sgn}(t)$. 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)

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

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 carries20 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 $x(n) = 5 + sin\left(\frac{n\pi}{2}\right) + cos\left(\frac{n\pi}{4}\right)$. Plot the magnitude and phase spectrum. (6)

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 excitation $x(n) = \left(\frac{4}{5}\right)^n u(n)$. Using Discrete Time Fourier transform, (8)

(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 $h(n) = \{1, 2, -1, 0, 3\}$ for the input $x(n) = \{1, 2, -1\}$. (3)

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)

Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FOURTH SEMESTER B.TECH DEGREE EXAMINATION(S), DECEMBER 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) Check whether the following signals are periodic or not. If periodic, find the fundamental period. (i) $x(t) = \sin(200\pi t) + \cos(150\pi t)$ (ii) $x[n] = \sin(0.15\pi n) + \cos(0.1\pi n)$ (8)

b) Check whether the system, $y(t) = x^2(2t)$ is (7)

(i) Linear (ii) Time-Invariant (iii) Causal (iv) Stable.

2 a) Given $x(t) = \begin{cases} t+1; -1 \le t \le 0 \\ 1-t; \ 0 \le t \le 1 \\ 0 \quad ; otherwise \end{cases}$ $h(t) = u(t-1) - u(t-3)$ (12)

Find $y(t) = x(t) * h(t)$; where '$*$' denotes convolution. Also plot $x(t)$, $h(t)$ and $y(t)$

b) Check the causality and stability of the LTI system with impulse response (3)

$h(t) = e^{-2t}u(t+2)$

3 a) Given $x(t) = u(t+1) + u(t-1) - u(t-2) - u(t-4)$. (8)

Plot (i) $x(t)$ (ii) $x(t-3)$ (iii) $x(2t)$ (iv) $x(2t-3)$

b) What is the condition for two signals $x(t)$ and $y(t)$ to be orthogonal? Give example of two signals which are orthogonal. (3)

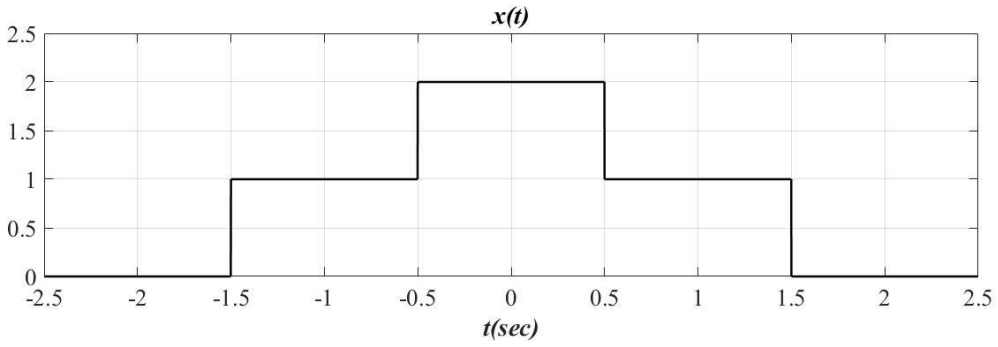
c) Show that the output of an LTI system with impulse response $h[n]$ to the input $x[n]$ is the convolution sum of $x[n]$ and $h[n]$. (4)

PART B

Answer any two full questions, each carries 15 marks.

4 a) State the conditions for convergence of Fourier Series. Also give an example (with waveform) each, for the signals that does not satisfy the conditions. (9)

b) Find the Fourier Transform of the following signal $x(t)$. (6)



5 a) Find the transfer function and ROC of the causal system represented by following differential equation. Also, find the impulse response of the system. (9)

$$\frac{d^2y(t)}{dt^2} + 9\frac{dy(t)}{dt} + 18\,y(t) = x(t)$$

b) (i) Find the Nyquist rate and Nyquist interval for the signals (a) sinc (100πt) and b) sinc (100πt) + sinc(50πt). (6)

6 a) What is ROC of Laplace Transform? State any 5 properties of ROC. (7)

b) How do we find magnitude response and phase response of an LTI system with impulse response ***h(t)***? What information about the system do they convey? (4)

c) What is aliasing? When does aliasing occur? How can we avoid aliasing? (4)

PART C

Answer any two full questions, each carries20 marks.

7 a) Solve the following difference equation using Z-transform (8)

y[n] = 7y[n-1]-12y[n-2]+2x[n]-x[n-2] for the input x[n]=u[n].

b) Find Discrete Time Fourier Series coefficients of the periodic sequence $x[n] = \begin{cases} 1; & 0 \le n \le 4 \\ 0; & 5 \le n \le 7 \end{cases}$ with fundamental period N = 8. (8)

c) Establish the relationship between DTFT and Z-transform (4)

8 a) Find the Z transform and ROC of the following sequences: (16)

1. δ[n]
2. 2^n u[n]
3. u[n]-u[n-3]
4. sin[ω_0n]u[n]

b) State whether the system with following transfer function is (i) causal (ii) stable. Give reason. (4)

$$H(z) = \frac{1}{1-2.5z^{-1}+z^{-2}};\ \text{ROC: } 0.5 < |z| < 2$$

9 a) Find the inverse z-transform using partial fraction method. (4)

X(z) = $0.25z^{-1}/(1-0.5z^{-1})(1-0.25z^{-1})$; ROC: |z|>0.5

b) Find DTFT of $x[n] = \begin{cases} 1; & 0 \le n \le 4 \\ 0; & Otherwise \end{cases}$ (6)

c) The impulse response of an LTI system in given by $h[n] = (0.3)^n u[n]$. Find the output ***y[n]*** of the system using Discrete Time Fourier Transform, for the input $x[n] = 2(0.1)^n u[n]$ (10)

****

Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Fourth semester B.Tech examinations (S), September 2020

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) Determine if the following signals are energy signals, power signals or neither. Calculate the Energy and Total average power for all signals. (6)

(i) $x(t) = (-0.5)^t u(t)$

(ii) $x(t) = A\sin(\Omega_0 t + \theta)$

(iii) $x[n] = u[n]$

b) Find (6)

$(i)\ x(t) * h(t),\ where\ x(t) = e^{-\alpha t}u(t)$ and $h(t) = e^{\alpha t}u(-t),\ \alpha > 0$

$(ii)\ Given\ \ x[n] = 1, n \geq 0$
$= 0, n < 0$ and $h[n] = 3\left(\frac{1}{2}\right)^n u[n] - 2\left(\frac{1}{3}\right)^{n-1} u[n]$,

Find $\lim_{n\to\infty} y[n]$, where $y[n] = x[n] * h[n]$

Here * represents convolution.

c) Check whether the given signals are periodic. If so, compute the period. (3)

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

(ii) $x[n] = \sin 2n$

2 a) Determine whether the following systems are (9)

a) causal, *b*) stable, *c*) linear, *d*) time invariant *e*) memoryless

(i) $y[n]=ax[n]+b$

(ii) $y(t) = v_m(t)\cos(\Omega_c t)$

(iii) $y(t) = \int_{-\infty}^{3t} x(\tau)d\tau$

b) Compute and plot the autocorrelation of the signal $x(t) = A\cos(\Omega_0 t + \theta)$, where θ is a constant between 0 and 2π (6)

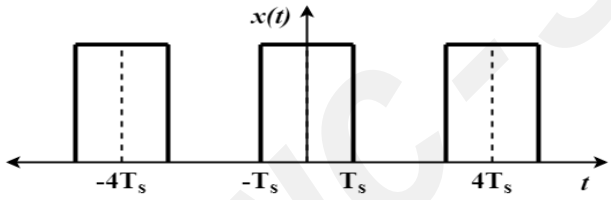
3 a) Find the convolution between the signals $x_1(t) = e^{-2t}u(t)$ & $x_2(t) = u(t+2)$ (8)

b) Find the output of a discrete LTI system described by the impulse response (7)
$h[n] = [2 \underset{\uparrow}{-4} \; 2]$, to the input $x[n] = [1 \; 2 \underset{\uparrow}{3} \; 2 \; 1]$

PART B

Answer any two full questions, each carries 15 marks.

4 a) Determine the Complex exponential Fourier series of the wave shown in figure. (9)



b) Obtain the Laplace transform of the following signals, indicating the region of convergence (ROC). (6)

$(i)\;\; x(t) = e^{-2t}u(t) + e^{-3t}u(t)$

$(ii)\; x(t) = e^{2t}u(-t) + e^{-3t}u(t)$

$(iii)\; x(t) = e^{2t}u(t) + e^{-3t}u(-t)$

5 a) Find the Fourier Transform of the gaussian pulse $x(t) = e^{-t^2}, \forall\, t.$ Plot the signal and its spectrum. (12)

b) Explain the relationship between the Fourier transform & Laplace transform. (3)

6 a) State the sampling theorem for a low pass signal. What is aliasing? (6)

b) Show that $\frac{d^n}{dt^n}x(t) \xleftrightarrow{\text{Unilateral LT}} s^n X_I(s) - s^{n-1}x(0^-) - s^{n-2}x'(0^-) + \ldots\ldots - x^{n-1}(0^-)$, (9)

where $X_I(s)$ is the unilateral Laplace Transform of $x(t)$, $x^{(r)}(0^-) = \frac{d^r}{dt}x(t)|_{t=0^-}$ and 0^- an arbitrarily small negative quantity.

PART C

Answer any two full questions, each carries20 marks.

7 a) Compute the *z*-Transform of the following sequences. (6)

$(i)\ x[n] = na^{n-1}u[n]$

$(ii)\ x[n] = a^{n+1}u[n+1]$

b) State the properties of the Region of Convergence (ROC) of *z*-transform. (5)

c) Find the inverse *z*-transform of $X(z) = \dfrac{2 + z^{-2} + 3z^{-4}}{z^2 + 4z + 3}, |z| > 0$ (9)

8 a) The output $y[n]$ of a discrete LTI system is $2\left(\frac{1}{3}\right)^n u[n], \text{for } x[n] = u[n].$ Find (10)

(i) impulse response $h[n]$ of the system

(ii) output of the system for $x[n] = \left(\frac{1}{2}\right)^n u[n]$

b) Consider a discrete time LTI system with $h[n] = \left(\frac{1}{2}\right)^n u[n]$. Use DTFT to determine the response of the system when excited with an input $x[n] = \left(\frac{3}{4}\right)^n u[n]$ (10)

9 a) Find the DTFT of $x[n]=u[n]-u[n-N]$ (8)

b) Consider the discrete LTI system $y[n] - \frac{1}{2}y[n-1] = x[n] + \frac{1}{2}x[n-1]$. Determine (12)

(i) The frequency response of the system $H\left(e^{j\omega}\right)$

(ii) Impulse response of the system $h[n]$

(iii) Response of the system to the input $x[n] = \cos\left(\frac{\pi}{2}n\right)$

****