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

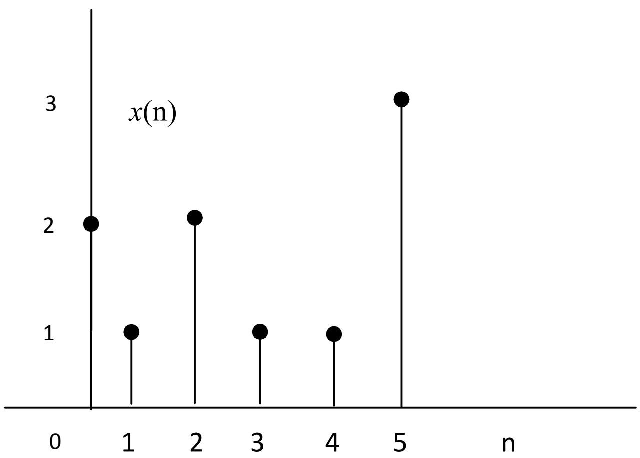
PART A

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

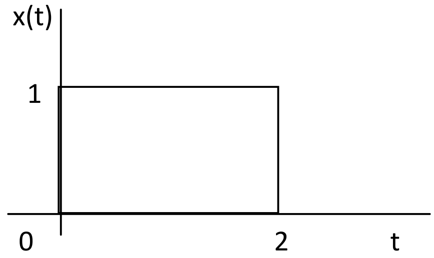
(i) $x(n) = \left(\frac{1}{3}\right)^n u(n)$

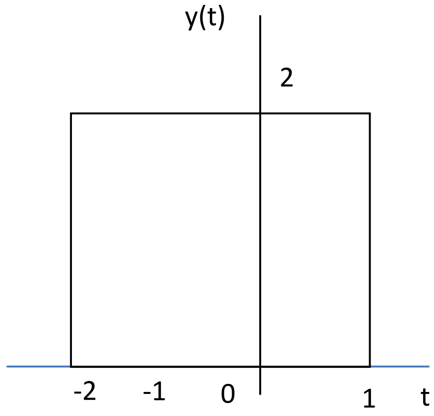
$(ii)\ y(t) = (1 + e^{-5t})u(t)$

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

$x(n) = \{1, \underset{\uparrow}{-2}, 3, 1\}$ $\qquad$ $y(n) = \{2, \underset{\uparrow}{-3}, -2\}$

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 $x(n) = \{\underset{\uparrow}{-2}, 1, 2, -1, 3\}$ 7

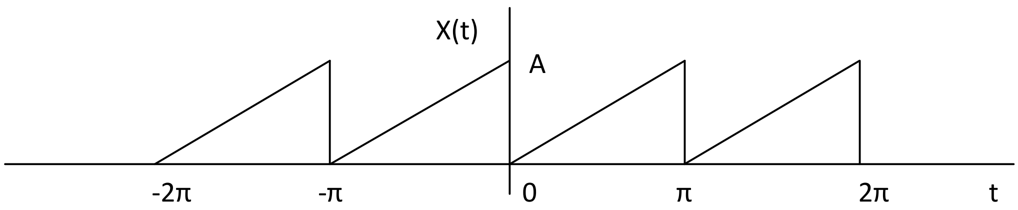
b) Find the convolution of the following signals and plot the result: 8

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

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

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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FOURTH SEMESTER B.TECH DEGREE EXAMINATION(R&S), MAY 2019

Course Code: EC202

Course Name: SIGNALS & SYSTEMS

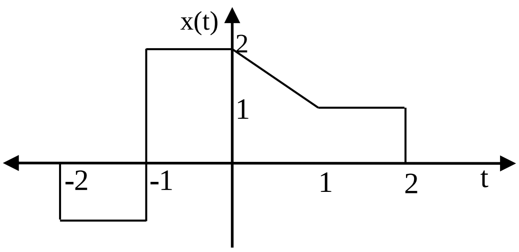
Max. Marks: 100 Duration: 3 Hours

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)

$$\mathrm{x(t) = \ 3\ Sin\ 200\pi t + 4\ Cos\ 100\pi t}$$

c) An LTI system is characterized by the impulse response $h(n) = [1, 2, 1]$. Find the system response for the given input $x(n) = [3, -1,\ 2\ , 0\ , 1]$. (7)

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

$$x(\mathrm{t}) = \cos t$$

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 $h(\mathrm{n}) = \mathrm{u(n) - u(n-3)}$. 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. Find the cross correlation of two finite length sequences $x(n) = [1, 3, 2, 2]$ and $y(n) = [1, 2,\ 3\ , 2]$. (5)

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 $x(t) = sgn(t)$. 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 $x(n) = \left(\frac{1}{2}\right)^n u(-n) - 2^n u(-n-1)$. Plot the pole-zero pattern. (8)

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)

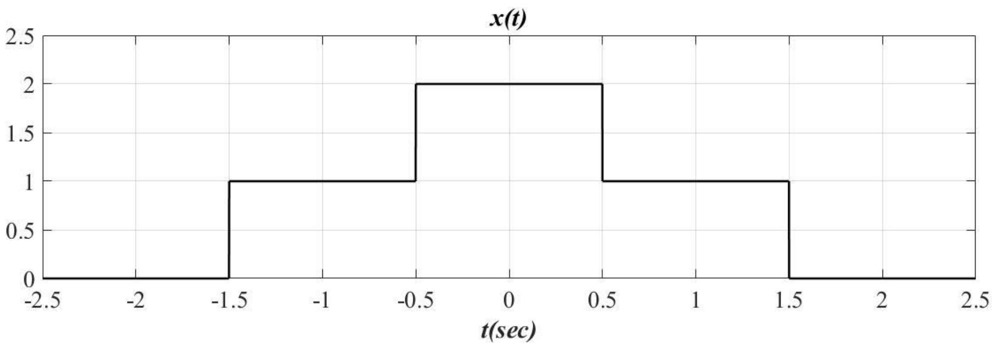
c) Show that the output of an LTI system with impulse response $h[n]$ to the input $x[n]$ is the convolution sum of $x[n]$ and $h[n]$. (4)

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 $x[n] = \begin{cases} 1; & 0 \le n \le 4 \\ 0; & 5 \le n \le 7 \end{cases}$ (8)

with fundamental period N = 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)

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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 $h(t) = e^{\alpha t}u(-t),\ \alpha > 0$

$(ii)\ Given\ \ x[n] = 1, n \ge 0$
$= 0, n < 0$ 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 $x(t) = A\cos\left(\Omega_0 t + \theta\right)$, where θ is a constant between 0 and 2π (6)

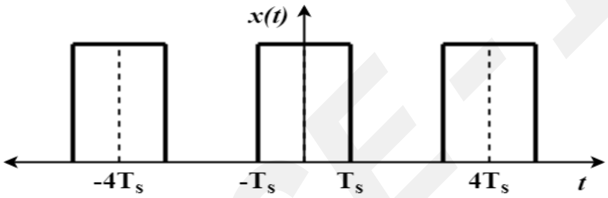
3 a) Find the convolution between the signals $x_1(t) = e^{-2t}u(t)$ & $x_2(t) = u(t+2)$ (8)

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

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 $\frac{d^n}{dt^n}x(t) \xleftrightarrow{\text{Unilateral LT}} s^n X_l(s) - s^{n-1}x(0^-) - s^{n-2}x'(0^-) + ... - x^{n-1}(0^-)$, where $X_l(s)$ is the unilateral Laplace Transform of $x(t)$, $x^{(r)}(0^-) = \frac{d^r}{dt}x(t)\big|_{t=0^-}$ and 0^- an arbitrarily small negative quantity. (9)

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 $x[n] = \cos\left(\frac{\pi}{2}n\right)$

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