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 $x(t) = A\cos\left(\Omega_0 t + \theta\right)$, 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)

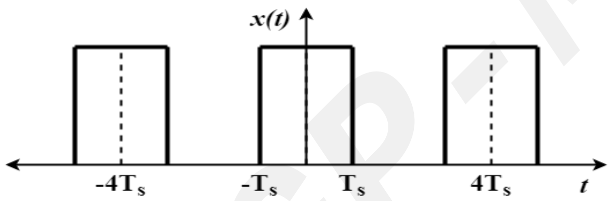
b) Find the output of a discrete LTI system described by the impulse response $h[n] = [2\ \ -4\ \ 2]$, to the input $x[n] = [1\ 2\ 3\ 2\ 1]$ (7)

$\uparrow$ (under the first 2 of $h[n]$) $\qquad \uparrow$ (under the 2 of $x[n]$)

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 $\dfrac{d^n}{dt^n}x(t) \xleftrightarrow{\text{Unilateral LT}} s^n X_l(s) - s^{n-1}x(0^-) - s^{n-2}x^{'}(0^-) + \ldots\ldots - x^{n-1}(0^-)$, (9)

where $X_l(s)$ is the unilateral Laplace Transform of $x(t)$, $x^{(r)}(0^-) = \dfrac{d^r}{dt}x(t)\,|_{t=0^-}$ 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 $x[n] = \cos\left(\frac{\pi}{2}n\right)$

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