

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. (6)  
Calculate the Energy and Total average power for all signals.

(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  $\lim_{n \rightarrow \infty} y[n]$ , 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)  $y(t) = \int_{-\infty}^{3t} x(\tau) d\tau$

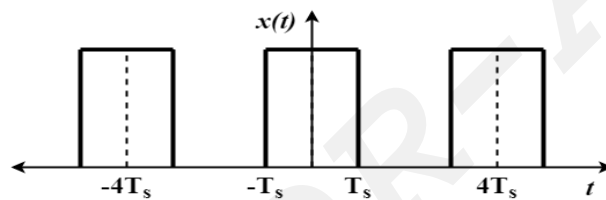
- b) Compute and plot the autocorrelation of the signal  $x(t) = A \cos(\Omega_0 t + \theta)$ , where  $\theta$  is a constant between 0 and  $2\pi$  (6)
- 3 a) Find the convolution between the signals  $x_1(t) = e^{-2t}u(t)$  &  $x_2(t) = u(t+2)$  (8)
- b) Find the output of a discrete LTI system described by the impulse response  $h[n] = [2 \ -4 \ 2]$ , to the input  $x[n] = [1 \ 2 \ 3 \ 2 \ 1]$  (7)
- ↑

↑

**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  $\frac{d^n}{dt^n} x(t) \xrightarrow{\text{Unilateral LT}} s^n X_l(s) - s^{n-1} x(0^-) - s^{n-2} x'(0^-) + \dots - x^{(n-1)}(0^-)$ , (9)

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

## PART C

Answer any two full questions, each carries 20 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  $X(z) = \frac{2+z^{-2}+3z^{-4}}{z^2+4z+3}, |z| > 0$  (9)
- 8 a) The output  $y[n]$  of a discrete LTI system is  $2\left(\frac{1}{3}\right)^n u[n]$ , 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 (10)
- the response of the system when excited with an input  $x[n] = \left(\frac{3}{4}\right)^n u[n]$
- 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  $H(e^{j\omega})$
- (ii) Impulse response of the system  $h[n]$
- (iii) Response of the system to the input  $x[n] = \cos\left(\frac{\pi}{2}n\right)$

\*\*\*\*