USN

10EE52

Fifth Semester B.E. Degree Examination, June/July 2018
Signals and Systems

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Sketch the even and odd components of the following signals.

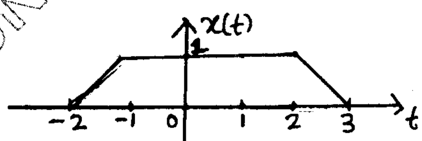

Fig Q1 a (i)

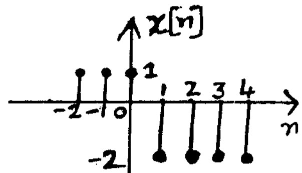

Fig Q1 a (ii) **(08 Marks)**

b. A continuous time signal x(t) shown below. Draw the signal $y(t) = \{x(t) + x(2-t)\}u(1-t)$

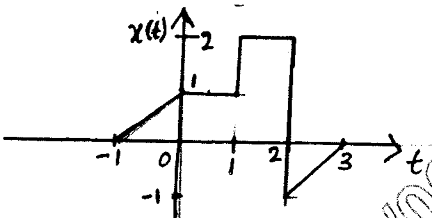

Fig Q1 (b) **(06 Marks)**

c. i) What is the average power of the triangular wave shown below?
ii) For the trapezoidal pulse shown below, find the total energy.

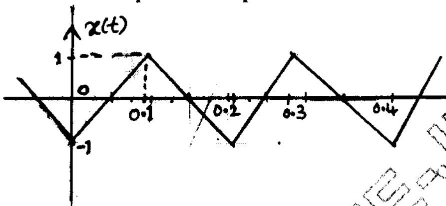

Fig Q1 c (i)

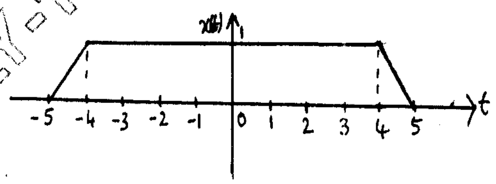

Fig Q1 c (ii) **(06 Marks)**

2 a. Derive an expression for convolution sum. **(06 Marks)**

b. If $h(t) = u(t) - u(t-3)$ and $x(t) = u(t) - u(t-1)$, determine the output $y(t) = x(t) * h(t)$. **(10 Marks)**

c. Determine the convolution of the two sequence $x[n] = \{1, \underset{\uparrow}{2}, 3, 4\}$ and $h[n] = \{\underset{\uparrow}{1}, 1, 3, 2\}$. **(04 Marks)**

3 a. Two LTI systems whose impulse responses are given by $h_1(t) = e^{-2t}u(t)$ and $h_2(t) = e^{-t}u(t)$ are connected in cascade. Find the overall impulse response h(t) and check for stability. **(06 Marks)**

b. Find the natural and forced responses of the system described by the differential equation.

$$\frac{d^2y(t)}{dt^2}+3\frac{dy(t)}{dt}+2y(t)=x(t)+\frac{dx(t)}{dt} \text{ With } y(0)=0, \left.\frac{dy(t)}{dt}\right|_{t=0}=1, x(t)=5u(t).$$ **(08 Marks)**

c. Draw the direct form I and direct form II for LTI system described by the difference equation $y[n]+\frac{1}{2}y[n-1]-\frac{1}{3}y[n-3]=x[n]+2x[n-2]$ **(06 Marks)**

4 a. State and prove frequency and time shift properties of Fourier series. **(08 Marks)**

b. Determine the DTFS representation for the sequence $x[n]=\cos^2\left[\frac{\pi}{4}n\right]$ **(06 Marks)**

c. Find the Fourier series coefficient of the signal x(t) shown below and draw its spectra.

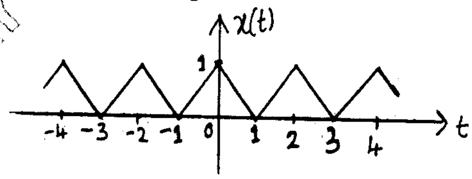

Fig Q4(c) **(06 Marks)**

PART – B

5 a. State and prove convolution property of the Discrete Time Fourier Transform (DTFT). **(06 Marks)**

b. Find DTFT of the sequence $x[n]=a^{|n|};|aK|$. **(04 Marks)**

c. Using appropriate properties, Find the DTFT of the signal $x[n]=\text{Sin}\left[\frac{\pi}{4}n\right]\left[\frac{1}{4}\right]^n u[n-1]$. **(10 Marks)**

6 a. State and prove Time differentiation and Frequency differentiation properties of the Fourier Transform (FT). **(08 Marks)**

b. Find the Fourier Transform of the following :
i) $x(t)=e^{-3t}u(t-1)$ ii) $x(t)=t\,e^{-2t}\,u(t)$ **(06 Marks)**

c. Find the Fourier Transform of the following signal using appropriate properties $x(t)=\text{Sin}(\pi t)e^{-2t}u(t)$. **(06 Marks)**

7 a. What is Region of Convergence (ROC)? List the properties of ROC. **(06 Marks)**

b. Determine the z – Transform of the following :

i) $x[n]=\left[\frac{1}{3}\right]^n \text{Sin}\left[\frac{\pi}{4}n\right]u[n]$ ii) $x[n]=\left[\frac{1}{2}\right]^{|n|}$ **(08 Marks)**

c. Using appropriate properties, find the z-transform of $x[n]=n\left[\frac{1}{2}\right]^n u[n-3]$. **(06 Marks)**

8 a. Solve the following difference equation using unilateral z-transform.

$y[n]-\frac{3}{2}y[n-1]+\frac{1}{2}y[n-2]=x[n],\ n>0$ With initial conditions $y[-1]=4$, $y[-2]=$

and $x[n]=\left[\frac{1}{4}\right]^n u[n]$. **(10 Marks)**

b. If a system is described by the following equation $y[n]-\frac{3}{4}y[n-1]+\frac{1}{8}y[n-2]=x[n]$, Find the impulse response and step response. **(10 Marks)**