CBCS SCHEME

USN | | | | | | | | | | **15EC44**

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

Time: 3 hrs. Max. Marks: 80

Note: *Answer FIVE full questions, choosing one full question from each module.*

Module-1

1 a. Sketch the even and odd part of the signals shown in Fig. Q1 (a)-(i) and Fig. Q1 (a)-(ii) **(08 Marks)**

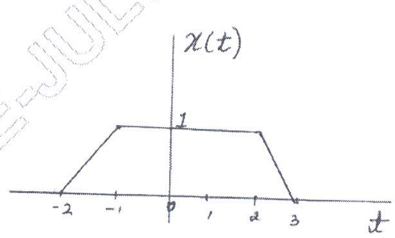

Fig. Q1 (a)-(i)

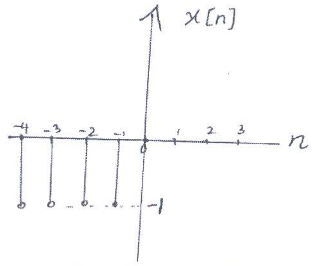

Fig. Q1 (a)-(ii)

b. The trapezoidal pulse x(t) shown in Fig. Q1 (b) is applied to a differentiator defined by,

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

Determine the resulting output y(t) and the total energy of y(t). **(08 Marks)**

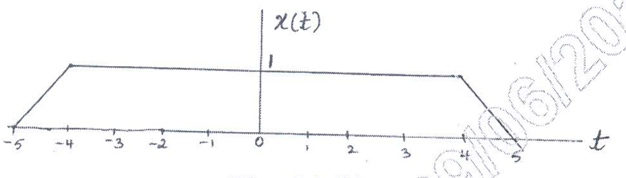

Fig. Q1 (b)

OR

2 a. Two systems are described by, (i) $y(n) = (n+1)x(n)$ (ii) $y(t) = x(t) + 10$. Test the systems for (i) Memory (ii) Causality (iii) Linearity (iv) Time-invariance and (v) Stability **(08 Marks)**

b. Let x(t) and y(t) be given in Fig. Q2 (b) respectively. Sketch the following signals, (i) $x(t)y(-t-1)$ (ii) $x(4-t)y(t)$ **(05 Marks)**

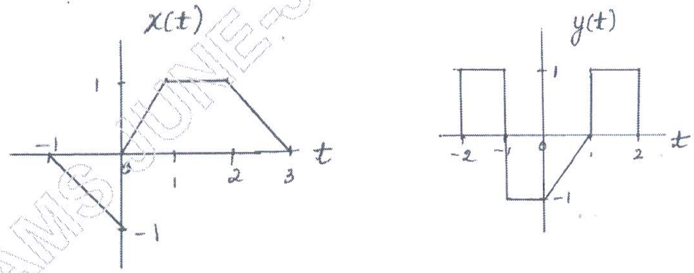

Fig. Q2 (b)

c. Determine whether the following signal is periodic or not. If periodic find the fundamental period, $x(n) = \cos\left(\frac{n\pi}{5}\right)\sin\left(\frac{n\pi}{3}\right)$. **(03 Marks)**

Module-2

3 a. Show that, (i) $x(t) * \delta(t - t_0) = x(t - t_0)$ (ii) $x(n) = \sum_{K=-\infty}^{\infty} x(k)\delta(n - K)$

(iii) $x(t) * u(t) = \int_{-\infty}^{t} x(z)dz$ **(08 Marks)**

b. Determine graphically, the output of a LTI system whose impulse response is $h(t) = \begin{cases} 4 & \text{for } 0 \le t \le 2 \\ 0 & \text{elsewhere} \end{cases}$

for the input $x(t) = \begin{cases} 2 & \text{for } -2 \le t \le 2 \\ 0 & \text{elsewhere} \end{cases}$ **(08 Marks)**

OR

4 a. Use the definition of the convolution sum to prove the following properties:

(i) $x(n) * (h_1(n) + h_2(n)) = (x(n) * h_1(n)) + (x(n) * h_2(n))$

(ii) $x(n) * h(n) = h(n) * x(n)$ **(08 Marks)**

b. Compute the convolution sum of,

$x(n) = \alpha^n [U(n) - U(n-8)]$, $|\alpha| < 1$ and

$h(n) = U(n) - U(n-5)$ **(08 Marks)**

Module-3

5 a. Determine the overall impulse response h(t) in terms of impulse response of each subsystem shown in Fig. Q5 (a). **(04 Marks)**

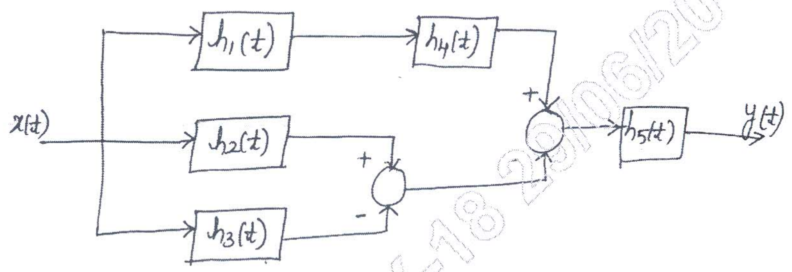

Fig. Q5 (a)

b. Determine whether the systems described by the following impulse responses are stable, causal and memoryless:

(i) $h(n) = \left(\frac{1}{2}\right)^n U(n)$ (ii) $h(t) = e^t u(-1-t)$ **(06 Marks)**

c. Find the DTFS coefficients of the signal shown in Fig. Q5 (c). **(06 Marks)**

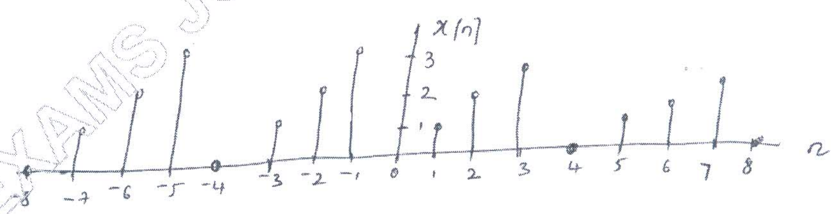

Fig. Q5 (c)

OR

6 a. Find the unit step response for the LTI systems represented by the following responses:

(i) $h(n) = \left(\frac{1}{2}\right)^n U(n-2)$ (ii) $h(t) = e^{-|t|}$ **(08 Marks)**

b. Find the Fourier series of the signal shown in Fig. Q6 (b), T = 2 **(08 Marks)**

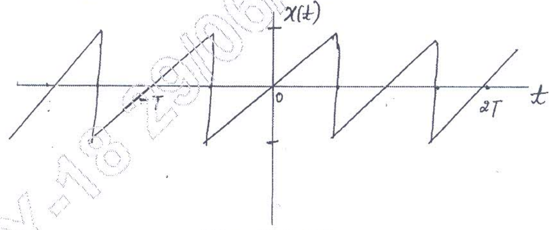

Fig. Q6 (b)

Module-4

7 a. State and prove the following properties of Discrete time Fourier transform:

(i) Frequency shift property (ii) Time differentiation property **(06 Marks)**

b. Find the Discrete time Fourier Transform of the following signals,

(i) $x(n) = a^{|n|}\ |a| < 1$ (ii) $x(n)=2^nU(-n)$ **(10 Marks)**

OR

8 a. Determine the Nyquist sampling rate and Nyquist sampling interval for,

(i) $x(t) = 1 + \cos 2000\pi t + \sin 4000\pi t$ (ii) $x(t) = 25e^{j500\pi t}$ **(05 Marks)**

b. Determine the Fourier transform of the following signals,

(i) $x(t) = e^{-3t}u(t-1)$ (ii) $x(t) = e^{-a|t|}\ a > 0$ **(06 Marks)**

c. Determine the time domain expression of $X(j\omega) = \frac{j\omega + 1}{(j\omega + 2)^2}$. **(05 Marks)**

Module-5

9 a. Determine the z-transform x(z), the ROC for the signals. Draw the ROC

(i) $x(n) = -\left(\frac{1}{2}\right)^n U[-n-1] - \left(-\frac{1}{3}\right)^n U[-n-1]$ (ii) $x(n) = -\left(\frac{3}{4}\right)^n U[-n-1] + \left(-\frac{1}{3}\right)^n U[n]$

(08 Marks)

b. State and prove the following properties of Z-transform:

(i) Time shift (ii) Convolution property. **(08 Marks)**

OR

10 a. The Z-transform of a sequence x(n) is given by, $x(z) = \frac{z(z^2 - 4z + 5)}{(z-3)(z-2)(z-1)}$.

find x(n) for the following ROCs

(i) $2 < |z| < 3$ (ii) $|z| > 3$ **(08 Marks)**

b. A causal system has input x(n) and output y(n). Find the impulse response of the system if,

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

$y(n) = \delta(n) - \frac{3}{4}\delta(n-1)$

Find the output of the system if the input is, $\left(\frac{1}{2}\right)^n U(n)$. **(08 Marks)**

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