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10EC44

Fourth Semester B.E. Degree Examination, Dec.2019/Jan.2020
Signals and Systems

Time: 3 hrs.

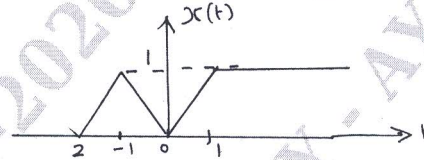
Max. Marks:100

Note: Answer any FIVE full questions, selecting atleast TWO questions from each part.

PART - A

- 1 a. Sketch the even and odd part of the signal shown in Fig. Q1(a). (06 Marks)

Fig.Q1(a)



- b. Find the energy of the signal

$$x(n) = \begin{cases} n, & 0 \leq n \leq 5 \\ 10 - n, & 6 \leq n \leq 10 \\ 0, & \text{otherwise} \end{cases}$$

(06 Marks)

- c. Let $x(t)$ and $y(t)$ are given in fig.Q1(c) respectively. Sketch the following signals
 i) $x(t) y(t-1)$ ii) $x(t-1) y(-t)$.

(08 Marks)

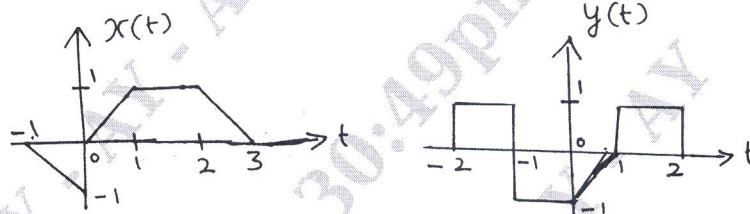


Fig.Q1(c)

- 2 a. An LT1 system has impulse response $h(n) = u(n+2) - u(n-2)$ and input $x(n) = u(n+5) - u(n-5)$, find the output of the system and sketch the output. (10 Marks)
 b. Use the definition of the convolution integral to derive the following properties :
 i) $x(t) * h(t) = h(t) * x(t)$ ii) $[x(t) * h_1(t)] * h_2(t) = x(t) * [h_1(t) * h_2(t)]$. (10 Marks)

- 3 a. Find the output of the system described by the differential equation with input and initial conditions are specified.

$$\frac{d^2y(t)}{dt^2} + 5 \frac{dy(t)}{dt} + 4y(t) = \frac{dx(t)}{dt} \text{ with } y(0) = 0, \quad \frac{dy(t)}{dt} \Big|_{t=0} = 1 \text{ and } x(t) = \sin t u(t).$$

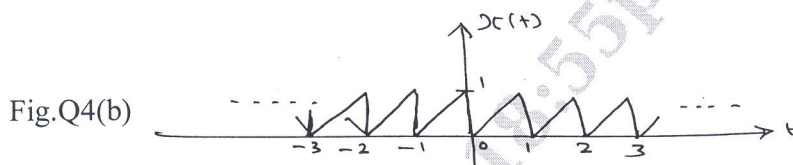
(08 Marks)

- b. Find the natural response of the system described by difference equation $y(n) - 4 y(n-2) = x(n-1)$ with $y(-1) = 1$ and $y(-2) = -1$. (06 Marks)
 c. Draw the Direct form - I and direct form - II implementation for the difference equation $y(n) + \frac{1}{2} y(n-1) - y(n-3) = 3x(n-1) + 2x(n-2)$. (06 Marks)

- 4 a. Prove the following properties of Continuous time Fourier series :
 i) Time shift ii) Frequency shift iii) Modulation. (12 Marks)

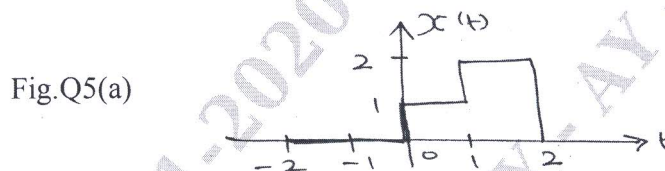
Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
 2. Any revealing of identification, appeal to evaluator and/or equations written eg. 42+8 = 50, will be treated as malpractice.

- b. Find the Complex Fourier Coefficient for the periodic waveform $x(t)$ shown in fig.Q4(b). (08 Marks)



PART - B

- 5 a. Find the Fourier Transform of the pulse $x(t)$ shown in fig. Q5(a). (06 Marks)



- b. Find the Fourier Transform of the signal $x(t) = e^{-at}$, $a > 0$. Also sketch the magnitude and phase spectra. (08 Marks)
- c. Find the Inverse Fourier Transform of

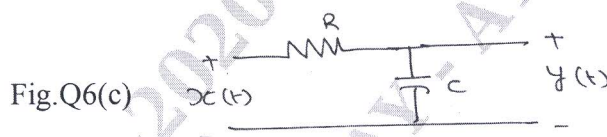
$$X(W) = \frac{jW}{(jW + 2)^2} \quad (06 \text{ Marks})$$

- 6 a. Obtain the Frequency response and impulse response of the system having output $y(n)$ for the input $x(n)$

$$x(n) = \left(\frac{1}{2}\right)^n u(n)$$

$$y(n) = \frac{1}{4} \left(\frac{1}{2}\right)^n u(n) + \left(\frac{1}{4}\right)^n u(n). \quad (08 \text{ Marks})$$

- b. A signal $x(t) = \cos(5\pi t) + 0.5 \cos(10\pi t)$ is ideally sampled with sampling period T_s . Find the Minimum Sampling frequency in Hz. (04 Marks)
- c. Find the Frequency response of the network shown in fig.Q6(c). Also find the impulse response of the network. (08 Marks)



- 7 a. What is ROC? Mention its properties. (06 Marks)
- b. Determine the Z - transform and ROC of the sequence

$$x(n) = 7\left(\frac{1}{3}\right)^n u(n) - 6\left(\frac{1}{2}\right)^n u(n). \quad (06 \text{ Marks})$$

- c. Determine Inverse Z - transform of the function

$$X(z) = \frac{1 - z^{-1} + z^{-2}}{\left(1 - \frac{1}{2}z^{-1}\right)\left(1 - 2z^{-1}\right)\left(1 - z^{-1}\right)}$$

With i) ROC : $|z| > 2$ ii) ROC : $|z| < \frac{1}{2}$.

Use Partial Fraction Expansion Method.

(08 Marks)