USN ☐☐☐☐☐☐☐☐☐☐   **17EC42**

Fourth Semester B.E. Degree Examination, July/August 2022
Signals and Systems

Time: 3 hrs.   Max. Marks: 100

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

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.

Module-1

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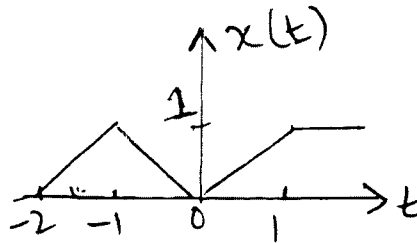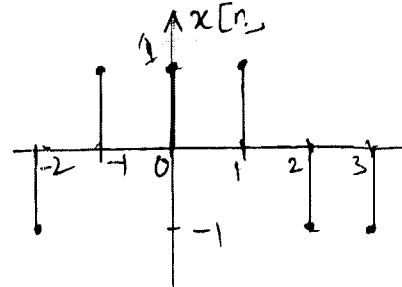

Fig Q1(a)(i)   Fig Q1(a)(ii)   **(10 Marks)**

  b.   Determine whether the following systems are memoryless, causal, time invariant linear and stable. i) y[n] = n x[n]   ii) y(t) = Cos (x(t))   **(10 Marks)**

OR

2   a.   A continuous time signal x(t) and g(t) is shown in Fig.Q2(a)(i) and (ii), express x(t) in terms of g(t).
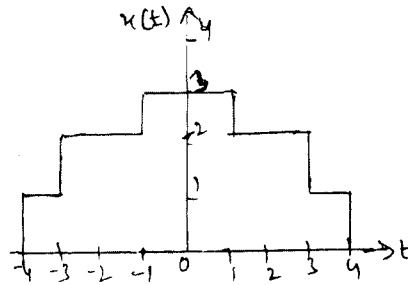

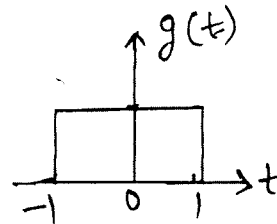Fig.Q2(a)(i)   Fig.Q2(a)(ii)   **(06 Marks)**

  b.   Determine whether the following signal is periodic or not. If periodic find the fundamental period. x(t) = Cos(5πt) + Sin (6πt).   **(04 Marks)**

  c.   For the signal x(t) and y(t) shown in Fig.Q2(c)(i) and (ii). Sketch the signal x(2t) y(2t + 1).

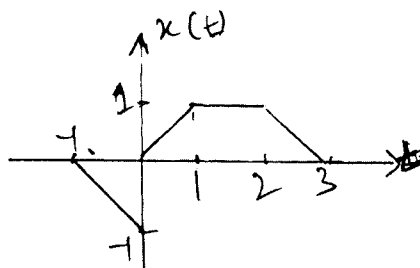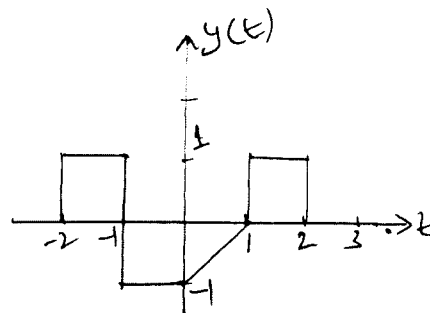Fig.Q2(c)(i)   Fig.Q2(c)(ii)   **(10 Marks)**

Module-2

3. a. Derive the equation for convolution sum. (06 Marks)

   b. State and prove commutative property of convolution sum. (04 Marks)

   c. Compute the following convolution

   i) $y(t) = u(t + 1) * u(t - 2)$ ii) $y[n] = \beta^n u[n] * [n - 3]$. (10 Marks)

OR

4. a. Compute the convolution integral of $x_1(t)$ and $x_2(t)$ given $x_1(t) = \cos \pi t(u(t + 1) - u(t - 3))$ $x_2(t) = u(t)$. (10 Marks)

   b. Consider a LTI system with input $x[n]$ and unit impulse response $h[n]$ given below. Compute and plot the output signal $y[n]$ $x[n] = 2^n u(-n)$ $h[n] = u[n]$. (10 Marks)

Module-3

5. a. Consider the interconnection of LTI systems depicted in Fig Q5(a). The impulse response of each system is given as $h_1[n] = u[n]$, $h_2[n] = u[n+2] - u[n]$, $h_3[n] = \delta[n - 2]$, $h_4[n] = \alpha^n u[n]$. Find the overall impulse response of the system.
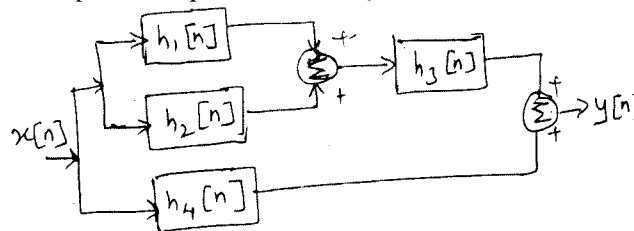

Fig Q5(a) (06 Marks)

   b. Determine whether the following system defined by their impulse response are memoryless, causal and stable. Justify your answer.

   i) $h(t) = e^t u(-1 - t)$ ii) $h[n] = \cos(n) u[n]$. (06 Marks)

   c. A continuous time LTI system has step response $s(t) = e^{-t} u(t)$. Find and sketch the output of the system to the input $x(t)$ shown in Fig Q5(c).
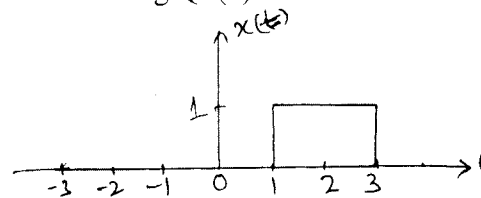

Fig Q5(c) (08 Marks)

OR

6. a. Determine the DTFS coefficients of $x[n] = \cos\left(\dfrac{6\pi}{13}n + \dfrac{\pi}{6}\right)$ and draw the magnitude spectrum and phase spectrum. (10 Marks)

   b. State the following properties of CTFS. i) Linearity   ii) Time shift   iii) Frequency shift   iv) Scaling   v) Time Differentiation   vi) Convolution. (10 Marks)

Module-4

7. a. State and prove the following properties

   i) $-jtx(t) \xleftrightarrow{FT} \dfrac{d\,x(w)}{dw}$ ii) $\int_{-\infty}^{\infty} |x(t)|^2\, dt = \dfrac{1}{2\pi} \int_{-\infty}^{\infty} |x(jw)|^2\, dw$ (10 Marks)

   b. The output $x(t)$ of an ideal low pass filter which has cut off frequency $w_c = 1000\pi$ rad/sec in impulse sampled with the following sampling periods i)$T_s = 0.5 \times 10^{-3}$ ii) $T_s = 2 \times 10^{-3}$ iii) $T_s = 10^{-4}$. Which of these sampling periods would guarantee that $x(t)$ can be recovered from its sampled version. (05 Marks)

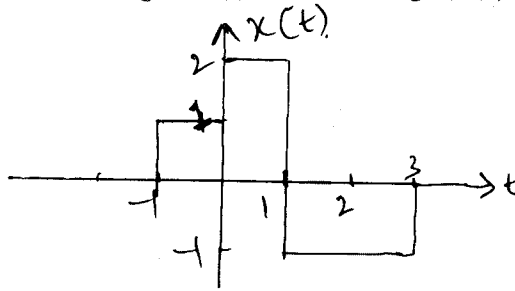c. Find the Fourier Transform for the signal x(t) shown in Fig Q7(c).

Fig Q7(c)   (05 Marks)

OR

8   a.   Find the DTFT of the following signals

i) $x[n] = 2^n u[-n]$ ii) $x[n] = Sin\left(\dfrac{\pi}{4}n\right)\left(\dfrac{1}{4}\right)^n u(n-1)$ (10 Marks)

b.   Determine the time domain signals corresponding to the following FT's

i) $x(jw) = e^{-|w|}$ ii) $x(jw) = \left(\dfrac{2jw+1}{(jw+2)^2}\right)$ (10 Marks)

Module-5

9   a.   State and prove Time Reversal and Differentiation in the z-domain property of Z-Transforms.   (10 Marks)

b.   Find the inverse Z-transform of

i) $x(z) = \dfrac{z^2 - 3z}{z^2 + \dfrac{3}{2}z - 1}$ $\dfrac{1}{2} < |z| < 2$ ii) $x(z) = \dfrac{8z^2 + 4z}{4z^2 - 4z + 1}$ $|z| > \dfrac{1}{2}$.   (10 Marks)

OR

10 a.   Use properties of z-transform to compute x(z) of

i) $x(n) = n\, Sin\left(\dfrac{\pi}{2}n\right)u(-n)$ ii) $x(n) = n^2\left(\dfrac{1}{2}\right)^n u(n-3)$ (12 Marks)

b.   Determine the transfer function and the impulse response for the causal LTI system if

$x(n) = \delta(n) + \dfrac{1}{4}\delta(n-1) - \dfrac{1}{8}\delta(n-2)$ and $y(n) = \delta(n) - \dfrac{3}{4}\delta(n-1)$.   (08 Marks)

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