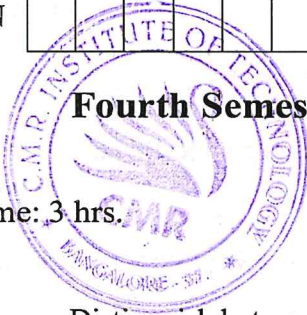


CBCS SCHEME

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17EC42



Fourth Semester B.E. Degree Examination, July/August 2021 Signals and Systems

Time: 3 hrs.

Max. Marks: 100

Note: Answer any FIVE full questions.

- 1 a. Distinguish between :
 - i) Periodic and non-periodic signals (04 Marks)
 - ii) Even and odd signals. (04 Marks)
- b. Determine whether the following systems are linear, causal, dynamic, time-variants and stable. i) $y(n) = 3x(n-1)$ ii) $y(t) = x(t^2)$. (08 Marks)
- c. Given the signal $x(t)$ as shown, sketch the following : i) $x(-2t+3)$ ii) $x(t/2-2)$.

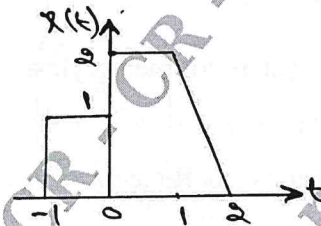


Fig.Q1(c)

(08 Marks)

- 2 a. Check whether the following signals are periodic or not. If periodic, determine their fundamental period. i) $x(t) = \cos 2t + \sin 3t$ ii) $x(n) = \cos\left(\frac{\pi n}{5}\right) \sin\left(\frac{\pi n}{3}\right)$. (06 Marks)
- b. Sketch the even and odd parts of the following signal, $x(t) = u(t+2) + u(t) - 2u(t-1)$. (08 Marks)
- c. Express : $x(t)$ in terms of $g(t)$, if $x(t)$ and $g(t)$ are as shown in Fig.Q2(c).

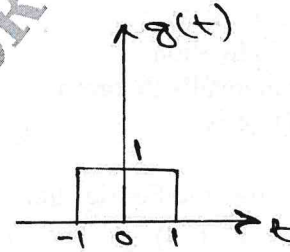
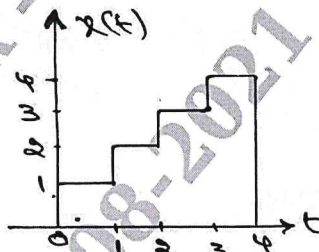


Fig.Q2(c)

(06 Marks)

- 3 a. Prove the following :
 - i) $x(t) * \delta(t-t_0) = x(t-t_0)$
 - ii) $x(n) * h(n) = h(n) * x(n)$. (04 Marks)
- b. Compute the convolution integral of $x(t) = e^{-3t}[u(t) - u(t-2)]$ and $h(t) = e^{-t}u(t)$. (08 Marks)
- c. Evaluate $y(t) = x(t) * h(t)$. $x(t)$ and $h(t)$ are shown in Fig.Q3(c).

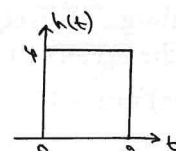
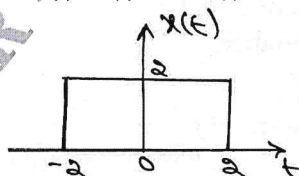


Fig.Q3(c)

(08 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.

- 4 a. Evaluate $y(n) = x(n) * h(n)$. If $x(n)$ and $h(n)$ are given as:
 $x(n) = \{2, 4, -2, 1, 7\}$ and $h(n) = \{2, 3, 1, 4\}$. (05 Marks)
- b. Compute the convolution sum of $x(n) = a^n u(n)$ and $h(n) = b^n u(n)$. (07 Marks)
 i) when $a > b$ ii) when $a < b$ iii) when $a = b$.
- c. Determine the response of an LTI system with input $x(n) = (1/3)^n u(n)$ and impulse response $h(n) = u(n) - u(n - 5)$. (08 Marks)

- 5 a. Calculate the step response of the LTI systems represented by following impulse responses.
 i) $h(n) = (1/2)^n u(n - 3)$ ii) $h(t) = \begin{cases} 1, & -2 \leq t \leq 0 \\ 0, & \text{elsewhere} \end{cases}$. (06 Marks)
- b. State any six properties of CTFS. (06 Marks)
- c. Determine the DTFS coefficients of $x(n) = \sin\left(\frac{4\pi n}{21}\right) + \cos\left(\frac{10\pi n}{21}\right) + 1$. Also sketch its magnitude and phase spectrum. (08 Marks)

- 6 a. Check the following LTI system for memoryless, causality and stability :
 i) $h(t) = e^t u(-1, -t)$ ii) $h(n) = \{2, 3, -1, 4\}$. (06 Marks)
- b. Determine the Fourier series coefficients of the signal shown in Fig.6(b) and also plot $|X \times (k)|$ and $\angle X(k)$.

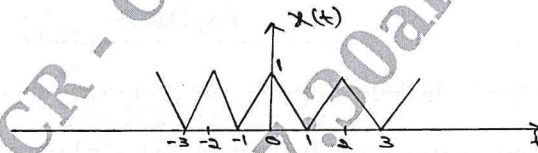


Fig.Q6(b)

(08 Marks)

- c. State the following properties DTFS :

- Time shifting
- Frequency shifting
- Convolution
- Modulation
- Parseval's theorem
- Duality.

(06 Marks)

- 7 a. Determine the Fourier transforms of the following :
 i) $x(t) = e^{at} u(-t)$ ii) $x(t) = e^{-a|t|}$, $a > 0$. (08 Marks)
- b. State and prove the following properties of DTFT :
 i) Convolution in time ii) Parseval's theorem. (06 Marks)
- c. Determine the Nyquist sampling rate and Nyquist sampling interval for the following signals:

i) $x(t) = \frac{1}{2\pi} [\cos(4000\pi t) \cos(1000\pi t)]$ ii) $y(t) = \sin C^2(200t)$. (06 Marks)

- 8 a. State and prove the following properties of CTFT :
 i) Time shifting ii) Frequency differentiation. (08 Marks)
- b. Determine the DTFTs of the following :
 i) $x(n) = (1/2)^n u(n - 4)$ ii) $x(n) = -a^n u(-n - 1)$. (08 Marks)
- c. State the sampling theorem and briefly explain how to practically reconstruct the signal. (04 Marks)

- 9 a. Define region of convergence. Mention its properties. (04 Marks)
- b. Using appropriate properties, find the z -transforms of the following signals : (08 Marks)
- i) $x(n) = n(n+1)u(n)$ ii) $x(n) = n(\frac{1}{3})^{n+3}u(n+3)$.
- c. Evaluate the inverse Z -transform of the following for all possible ROCs. (08 Marks)
- $$X(z) = \frac{z(z^2 - 4z + 5)}{(z-3)(z^2 - 3z + 2)}$$
- 10 a. State and prove the following properties of Z -transform : (06 Marks)
- i) Time Reversal ii) Scaling in Z -domain.
- b. Find the Z -transform of $x(n) = 2^n u(n) + 3^n u(-n-1)$ and draw its pole-zero plot. (04 Marks)
- c. Compute the response of the system : $y(n) = 0.7y(n-1) - 0.12y(n-2) + x(n-1) + x(n-2)$ to the input $x(n) = n u(n)$. Also check whether the system is stable. (10 Marks)
