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.***

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.

1 a. Distinguish between :
i) Periodic and non-periodic signals
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) $x(t/2-2)$.

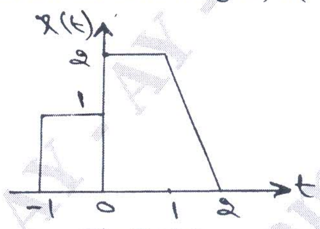

Fig.Q1(c) **(08 Marks)**

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) interms 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).

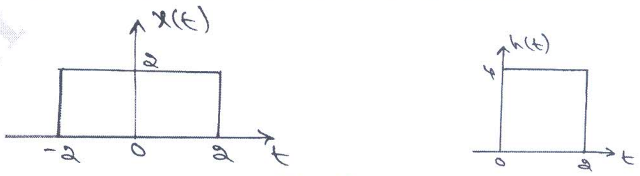

Fig.Q3(c) **(08 Marks)**

4 a. Evaluate $y(n) = x(n) * h(n)$. If $x(n)$ and $h(n)$ are given as :
$x(n) = \{2, \underset{\uparrow}{4}, -2, 1, 7\}$ and $h(n) = \{2, 3, \underset{\uparrow}{1}, 4\}$. **(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) $h(t) = \begin{cases} 1, & -2 \le t \le 0 \\ 0, & \text{elsewhere} \end{cases}$. **(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) $h(n) = \{\underset{\uparrow}{2}, 3, -1, 4\}$. **(06 Marks)**

b. Determine the Fourier series coefficients of the signal shown in Fig.6(b) and also plot $|X \times (k)|$ and $< X(k)$.

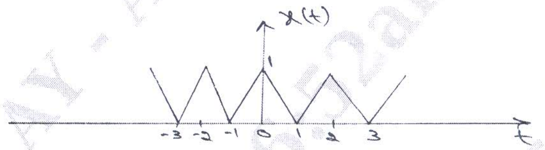

Fig.Q6(b) **(08 Marks)**

c. State the following properties DTFS :
i) Time shifting
ii) Frequency shifting
iii) Convolution
iv) Modulation
v) Parseval's theorem
vi) 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 :

i) $x(n) = n(n + 1)\,u(n)$ ii) $x(n) = n(1/3)^{n+3}\,u(n + 3)$. **(08 Marks)**

c. Evaluate the inverse Z – transform of the following for all possible ROCs.

$$X(z) = \frac{z(z^2 - 4z + 5)}{(z-3)(z^2 - 3z + 2)}.$$ **(08 Marks)**

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

i) Time Reversal ii) Scaling in Z–domain. **(06 Marks)**

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)**

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