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CBCS SCHEME

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15EC44

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

Time: 3 hrs. Max. Marks: 80

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. Determine whether the discrete-time signal,

$x(n) = \cos\left(\frac{n\pi}{4}\right)\sin\left(\frac{2\pi}{5}\right)$ is periodic. If periodic, find the fundamental period. **(05 Marks)**

b. Determine and sketch even and odd parts of the signal shown in the Fig.Q1(b).

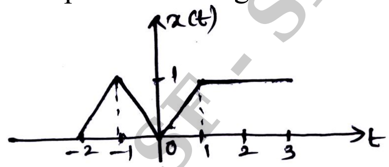

Fig.Q1(b) **(06 Marks)**

c. Prove the following properties of Impulse function:
i) $x(t) * \delta(t) = x(t)$ (ii) $x(t) * \delta(t - t_0) = x(t_0)$ **(05 Marks)**

OR

2 a. Determine whether the following systems are memoryless, causal, linear, time invariant and stable:
(i) $y(n) = n\,x(n)$ (ii) $y(t) = x(t/2)$ $|x(t)| \le Mx < \infty$ **(10 Marks)**

b. Sketch the waveforms of the following signals :
(i) $x(t) = u(t + 1) - 2u(t) + u(t - 1)$
(ii) $y(t) = r(t + 1) - r(t) + r(t - 2)$
(iii) $z(t) = -u(t + 3) + 2u(t + 1) - 2u(t - 1) + u(t - 3)$ **(06 Marks)**

Module-2

3 a. An LTI system is characterized by an impulse response $h(n) = (1/2)^n u(n)$. Find the response of the system for the input $x(n) = (1/4)^n u(n)$. **(06 Marks)**

b. Find the convolution sum of the given two sequences $x(n) = \{1, 2, 3, 2\}$, $h(n) = \{1, 2, 2\}$ by using graphical convolution method. **(10 Marks)**

OR

4 a. Determine the convolution sum of the given sequences
$x(n) = \{3, 5, \underset{\uparrow}{-2}, 4\}$ and $h(n) = \{3, 1, 3\}$. **(08 Marks)**

b. Perform graphical convolution to determine the output of the system, when the input and impulse response are given by $x(t) = e^{-4t}[u(t) - u(t - 2)]$; $h(t) = e^{-2t} u(t)$. **(08 Marks)**

Module-3

5 a. For each impulse response listed below, determine whether the corresponding system is memoryless, causal and stable.
i) $h(n) = (0.99)^n u(n - 3)$ ii) $h(t) = e^{-3t} u(t - 1)$ **(08 Marks)**

b. Find the complex exponential fourier series representation of the following signals:
i) $x(t) = \sin(2t + \pi/4)$ ii) $x(t) = \cos^2(t)$ **(08 Marks)**

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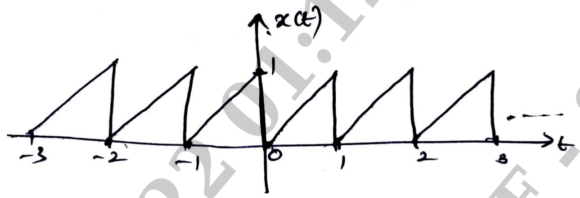
OR

6 a. Find the complex fourier series coefficients for the periodic waveform shown in Fig.Q6(a). Also draw the amplitude and phase spectra.



$x(t) = t ; \quad 0 < t < 1.$

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

b. Find the step response of an LTI system, whose impulse response is given by the following:
i) $h(t) = t^2 u(t)$ ii) $h(t) = e^{-t} u(t)$ **(08 Marks)**

Module-4

7 a. Show that the fourier transform of a rectangular pulse described by :

$$x(t) = 1 \quad ; \quad -T \le t \le T$$
$$= 0 \quad ; \quad |t| > T$$

is a sinc function. Plot its magnitude and phase spectrum. **(08 Marks)**

b. If $x(t) \xleftrightarrow{FT} X(jw)$ or $X(e^{jw})$ and $y(t) \xleftrightarrow{FT} Y(jw)$ or $Y(e^{jw})$,
Show that $z(t) = x(t) * y(t) \xleftrightarrow{FT} X(jw)Y(jw)$ or $X(e^{jw})Y(e^{jw})$ **(08 Marks)**

OR

8 a. State sampling theorem and explain aliasing effect with relevant waveforms. **(04 Marks)**

b. Specify Nyquist rate and Nyquist interval for each of the following signals.
i) $x(t) = \sin c^2(2000t)$
ii) $y(t) = \sin c(200t) + \sin c^2(200t)$ **(06 Marks)**

c. Find the DTFT of the signal $a^n u(n)$ its magnitude and phase spectrum. **(06 Marks)**

Module-5

9 a. Using properties of z-transform, find the convolution of
$x(n) = \{\underset{\uparrow}{1}, 2, -1, 0, 3\}$ and $y(n) = \{\underset{\uparrow}{1}, 2, -1\}$ **(05 Marks)**

b. State and prove differentiation property of Z-transform. **(06 Marks)**

c. Find the z-transform of $x(n) = \alpha^{|n|}$, $|\alpha| \# 1$ and determine its ROC. **(05 Marks)**

OR

10 a. A causal discrete-time LTI system is described by

$$y(n) - \frac{3}{4}y(n-1) + \frac{1}{8}y(n-2) = x(n)$$

where x(n) and y(n) are the input and output of the system respectively.
i) Determine the system function, H(z)
ii) Find the impulse response, h(n)
iii) Find the step response of the system
iv) Find the frequency response of the system.
v) Find BIBO stability of the system. **(10 Marks)**

b. Find the inverse z-transform of the funciton

$$X[z] = \frac{z-4}{z^2 - 5z + 6}$$ **(06 Marks)**

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