CBCS SCHEME

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17EC42

Fourth Semester B.E. Degree Examination, Jan./Feb. 2021
Signals and Systems

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Define a signal. List the elementary signals. Differentiate between even and odd signals, energy and power signals. **(08 Marks)**

b. Sketch the signal $x(t) = r(t+1) - r(t) + r(t-1)$. **(04 Marks)**

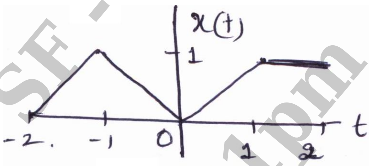
c. Check whether the following signals are periodic or not. If periodic, determine the fundamental period:

i) $x(n) = \cos\left(\frac{\pi n}{2}\right) + \sin\left(\frac{\pi n}{4}\right)$ ii) $x(t) = \cos(2\pi t)\ \sin\ 4\pi t$ **(08 Marks)**

OR

2 a. Determine and sketch the even and odd components of the signal x(t) shown in Fig.Q.2(a). **(08 Marks)**

Fig.Q.2(a)



b. Find and sketch the derivatives of the following signals: $x(t) = u(t) - u(t-a)$, $a > 0$. **(04 Marks)**

c. Check whether the following system is
i) Static or dynamic
ii) Linear or nonlinear
iii) Time invariant or time variant
iv) Causal or non causal
v) Stable or unstable
vi) Invertible or non invertible. $y(n) = \log[x(n)]$. **(08 Marks)**

Module-2

3 a. Derive the expression for convolution integral. **(07 Marks)**

b. Prove the following: i) $x(n) * \delta(n) = x(n)$ ii) $x(n) * u(n) = \sum_{k=-\infty}^{n} x(k)$ **(06 Marks)**

c. Consider a LTI system with unit impulse response $h(t) = e^{-t}u(t)$. If the input applied to this system is $x(t) = e^{-3t}(u(t) - u(t-2))$. Find the output y(t) of the system. **(07 Marks)**

OR

4 a. State and prove commutative and distributive properties of convolution integral. **(08 Marks)**

b. The impulse response of LTI system is $h(n) = \{1, \underset{\uparrow}{2}\}$. Determine the response of the system to input signal $x(n) = \{1, \underset{\uparrow}{3}, 1\}$ using graphical method. **(06 Marks)**

c. Find the discrete time convolution sum given below:
$y(n) = \beta^n u(n) * \alpha^n u(n), |B| < 1, |\alpha| < 1$ **(06 Marks)**

Module-3

5 a. The LTI systems are connected as shown in Fig.Q.5(a). If $h_1(n) = u(n-2)$, $h_2(n) = nu(n)$ and $h_3(n) = \delta(n-2)$. Find the overall response. **(10 Marks)**

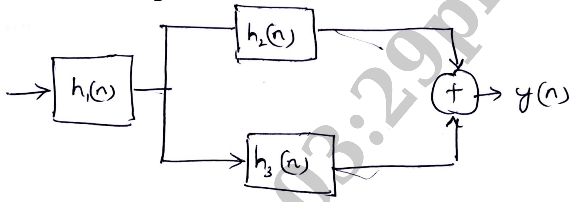


Fig.Q.5(a)

b. Evaluate the DTFS representation for the signal

$$x(n) = \sin\left(\frac{4\pi}{21}n\right) + \cos\left(\frac{10\pi}{21}n\right) + 1$$

Sketch the magnitude and phase spectra. **(10 Marks)**

OR

6 a. State and explain following continuous time Fourier series properties:
i) Time shift ii) Convolution iii) Parseval's Theorem. **(06 Marks)**

b. Check whether the system whose impulse response is
i) $h(n) = (1/2)^n u(-n)$ ii) $h(t) = e^{2t} u(t-1)$ stable, causal and memory less. **(09 Marks)**

c. Evaluate the step response for the LTI system represented by the following impulse response. $h(t) = t^2 u(t)$. **(05 Marks)**

Module-4

7 a. State the following properties of DTFT: i) Linearity ii) Frequency shift iii) Frequency differentiation iv) Modulation v) Convolution. **(10 Marks)**

b. Obtain the FT of the signal $x(t) = e^{-at} u(t)$; $a > 0$. **(10 Marks)**

OR

8 a. Find DTFT of the signal $x(n) = \{1, 3, \underset{\uparrow}{5}, 3, 1\}$ and evaluate $X(e^{j\Omega})$ at $\Omega = 0$ **(06 Marks)**

b. With neat diagrams, state and explain sampling theorem. **(08 Marks)**

c. Determine the Nyquist sampling rate and Nyquist sampling interval for
i) $x_1(t) = \text{Cos}(5\pi t) + 0.5\cos(10\pi t)$ ii) $x_2(t) = \text{Sinc}^2(200t)$ **(06 Marks)**

Module-5

9 a. Define Z-transform. Mention the properties of Region of Convergence (ROC). **(06 Marks)**

b. Determine the Z transform of these signals

i) $x_1(n) = n\left(\frac{5}{8}\right)^n u(n)$ ii) $x_2(n) = (0.9)^n u(n) * (0.6)^n u(n)$ **(08 Marks)**

c. Find Inverse Z transform, if $X(z) = \dfrac{\left(\frac{1}{4}\right)z^{-1}}{\left(1 - \frac{1}{2}z^{-1}\right)\left(1 - \frac{1}{4}z^{-1}\right)}$ for all possible ROCs. **(06 Marks)**

OR

10 a. Prove the following properties of Z-transform: i) Linearity ii) Time Reversal. **(08 Marks)**

b. A system has impulse response $h(n) = \left(\frac{1}{2}\right)^n u(n)$. Determine the input to the system if the output is given by $y(n) = \frac{1}{3}u(n) + \frac{2}{3}\left(-\frac{1}{2}\right)^n u(n)$. **(12 Marks)**

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