CBCS SCHEME

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17MT73

Seventh Semester B.E. Degree Examination, July/August 2022
Signal Process

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Explain the classification of signals :
(i) Continuous time and discrete time signals.
(ii) Analog and Digital signal.
(iii) Deterministic and random signal.
(iv) Even and Odd signal.
(v) Periodic and Non periodic signals. **(10 Marks)**

b. A discrete time signal x(n) is described by,

$$x(n) = \begin{cases} 1 & n \geq 1,2,3 \\ -1 & n = -1, -2, -3 \\ 0 & n = 0,\ |n| > 3 \end{cases}.$$

Find $y(n) = x(2n+2)$. **(10 Marks)**

OR

2 a. Explain energy and power signal. Find the average power of the signal $x(n) = u(n)$, where u(n) is shown in Fig. Q2 (a) below. **(10 Marks)**

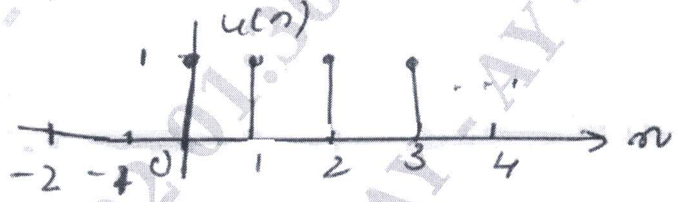

Fig. Q2 (a)

b. Find the even and odd component of $x(t) = e^{jt}$. **(04 Marks)**

c. A discrete time signal x(n) is shown in Fig. Q2 (c). Sketch and label of following signals :
(i) $x(n-2)$
(ii) $x(2n)$
(iii) $x(-n)$

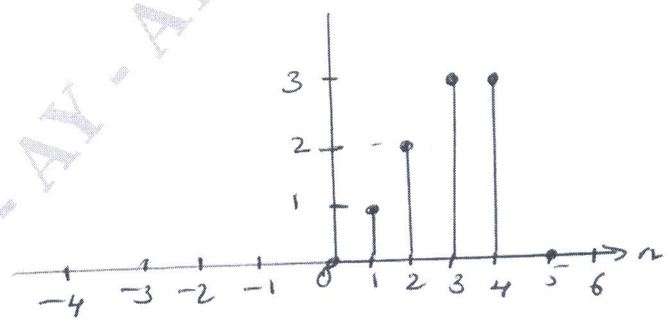

Fig. Q2 (c) **(06 Marks)**

Module-2

3 a. Find the convolution sum of the 2 sequences $x_1(n)$ and $x_2(n)$ given below:

$x_1(n) = \{1, \underset{\uparrow}{2}, 3\}$

$x_2(n) = \{2, \underset{\uparrow}{1}, 4\}$

Also show that :

$x(n) * \delta(n) = x(n)$

$x(n) * \delta(n - n_0) = x(n - n_0)$ **(10 Marks)**

b. An LTI system is characterised by an impulse response,

$$h(n) = \left(\frac{3}{4}\right)^n u(n)$$

Find the step response of the system. Also evaluate the output of the system $n = \pm 5$. **(10 Marks)**

OR

4 a. With the relevant equations state and expalin the convolutional integral. **(10 Marks)**

b. Convolute the two continuous time signals $x_1(t)$ and $x_2(t)$ given below:

$x_1(t) = \cos \pi t \, [u(t+1) - u(t-3)]$.

$x_2(t) = u(t)$ **(10 Marks)**

Module-3

5 a. State the definition of Discrete Fourier Transform :

Compute the 8 point DFT of the sequence, $x(n) = \{1,1,1,1,0,0,0,0\}$. **(10 Marks)**

b. Compute the DFT of the sequence defined by $x(n) = (-1)^n$ for,

(i) $N = 3$, (ii) $N = 4$, (iii) N odd, (iv) Never. **(10 Marks)**

OR

6 a. Find the 8 point DFT of the sequence :

$x(n) = \{1, 2, 3, 4, 4, 3, 2, 1\}$

Using DIT-FFT radix 2 algorithm. The basic computational block known as the butterfly should be as shown in Fig. Q6 (a) below. **(12 Marks)**

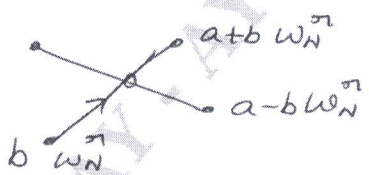

Fig. Q6 (a)

b. Compute the 4 point DFT of the sequence $x(n) = (1, 0, 1, 0)$.

Also find y(n) if $Y(K) = X((K-2))_4$. **(08 Marks)**

Module-4

7 a. A Butterworth low pass filter has to meet the following specifications:

(i) Passband gain $K_p = -1$ dB at $\Omega_p = 4$ rad/sec.

(ii) Stop band attenuation greater than or equal to 20 dB at $\Omega_s = 8$ rad/sec.

Determine the transfer function $H_a(S)$ of the lowest order Butterworth filter to meet the above specifications. **(12 Marks)**

b. Find the order N of the following low pass Butterworth filter to meet the specifications :

$\delta_p = 0.001$, $\delta_s = 0.001$, $\Omega_p = 1$ rad/sec, $\Omega_s = x$ rad/sec. **(08 Marks)**

OR

8 a. A third order Butterworth low pass filter has the transfer function,

$$H(s)=\frac{1}{(s+1)(s^2+s+1)}.$$

Design H(z) using impulse invariant technique. **(10 Marks)**

b. Determine the system function H(z) of the lowest order Chebyshev filter that meets the following specifications :

i) 3 dB ripple in the passband $0 \le |\omega| \le 0.3\pi$.

ii) At least 20 dB attenuation in the stopband $0.6\pi \le |\omega| \le \pi$.

Use the bilinear transformation. **(10 Marks)**

Module-5

9 a. A low pass filter is to be designed with the following desired frequency response:

$$H_d(e^{j\omega}) = H_d(\omega) = \begin{cases} e^{-j2\omega}, & |\omega| < \frac{\pi}{4} \\ 0, & \frac{\pi}{4} < |\omega| < \pi \end{cases}.$$

Determine the filter coefficients $h_d(n)$ and h(n) if $\omega(n)$ is a rectangular window defined as follows:

$$\omega_r(n) = \begin{cases} 1, & 0 \le n \le 4 \\ 0, & \text{otherwise} \end{cases}.$$

Also find frequency response $H(\omega)$ of the resulting FIR filter. **(10 Marks)**

b. The frequency response of an FIR filter is given by,
$H(\omega) = e^{-j3\omega}(1+1.8\cos 3\omega+1.2\cos 2\omega+0.5\cos\omega)$ Determine the coefficients of the impulse response h(n) of the FIR filter. **(10 Marks)**

OR

10 a. Draw the block diagram of direct form I and direct form II realizations for a digital IIIR filter described by system functions : $H(z)=\frac{8z^3-4z^2+11z-2}{\left(\frac{z-1}{4}\right)\left(z^2-z+\frac{1}{2}\right)}$. **(10 Marks)**

b. Obtain a cascade realization for a system described by,

$$H(z)=\frac{1+\frac{1}{4}z^{-1}}{\left(1+\frac{1}{2}z^{-1}\right)\left(1+\frac{1}{2}z^{-1}+\frac{1}{4}z^{-2}\right)}.$$ **(10 Marks)**

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