CBCS SCHEME

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15MT73

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

Time: 3 hrs. Max. Marks: 80

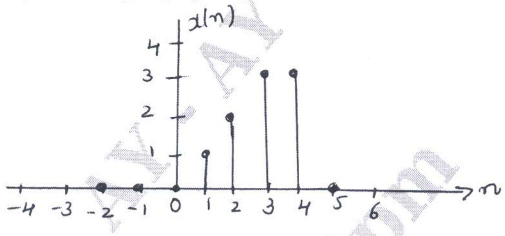
Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Illustrate the following with examples each:
i) Even and odd signals
ii) Energy and power signals
iii) Continuous and discrete signals.
Find the even and odd components of $x(t) = e^{jt}$. **(08 Marks)**

b. A discrete time signal x(n) is shown in Fig.Q.1(b), sketch and label each of the following signals: i) x(n-2) ii) x(2n) iii) x(-n) **(08 Marks)**

Fig.Q.1(b)



OR

2 a. For a system described by $T\{x(n)\} = ax(n) + b$ check for the following properties:
i) Stability ii) Causality iii) Linearity iv) Time invariance v) Memory. **(10 Marks)**

b. Determine whether each of the following signals is periodic. If a signal is periodic, find its fundamental period. i) $x(n) = 5\cos(0.2\pi n)$ ii) $x(n) = \sin(2n)$. **(06 Marks)**

Module-2

3 a. State and prove convolutional integral. **(08 Marks)**

b. An LTI system is characterized 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 $n = \pm 5$. **(08 Marks)**

OR

4 a. State and prove the convolutional sum. **(08 Marks)**

b. Find the convolutional sum of two sequences $x_1(n)$ and $x_2(n)$ given below:
i) $x_1(n) = (\underset{\uparrow}{1}, 2, 3)$ ii) $x_2(n) = (\underset{\uparrow}{2}, 1, 4)$ **(08 Marks)**

Module-3

5 a. State the definition of Discrete Fourier Transform (DFT), compute the 8 point DFT of the sequence x(n) given below:
$x(n) = (1, 1, 1, 1, 0, 0, 0, 0)$. **(10 Marks)**

b. Find the N point DFT of the following sequences:
i) $x_1(n) = \delta(n)$ ii) $x_2(n) = \delta(n-n_0)$ **(06 Marks)**

OR

6 a. Explain the properties of DFT.
i) Linearity ii) Circular time shift.
Find the 4 point DFT of the sequence $x(n) = (1, -1, 1, -1)$. Also using time shift property find the DFT of the sequence $y(n) = x((n-2))_4$. **(10 Marks)**

b. Compute the 4 point DFT of sequence $x(n) = (1, 0, 1, 0)$. Also find y(n) if $y(k) = x((k-2))_4$. **(06 Marks)**

Module-4

7 a. A Butterworth low pass filter has to meet the following specifications:
i) Passband gain, K_P = -1dB at Ωp = 4rad/sec.
ii) Stop band attenuation greater than or equal to 20dB at Ω_s= 8rad/sec.
Determine the transfer function Ha(s) of the lowest order Butterworth filter to meet the above specifications. **(10 Marks)**

b. Find the order N of a low pass Butterworth filter to meet the following specifications:
$\delta_p = 0.001$, $\delta_s = 0.001$, $\Omega_p = 1$rad/sec, $\Omega_s = 2$rad/sec. **(06 Marks)**

OR

8 a. Design a Chebyshev analog low pass filter that has a -3dB cutoff frequency of 100 rad/sec and a stop band attenuation of 25dB or greater for all radian frequencies past 250rad/sec. **(10 Marks)**

b. Let $Ha(s) = \dfrac{b}{(s+a)^2 + b^2}$ be a casual second order analog transfer function. Show that the casual second order digital transfer function H(z) obtained from Ha(s) through impulse invariance method is given by

$$H(z) = \frac{e^{-aT} \sin bT z^{-1}}{1 - 2e^{-aT} \cos bT z^{-1} + e^{-2aT} z^{-2}}.$$ Also find H(z) when $Ha(s) = \dfrac{1}{s^2 + 2s + 2}$. **(06 Marks)**

Module-5

9 a. The frequency response of an FIR filter is given by
$$H(W) = e^{-j3w}(1 + 1.8\cos 3w + 1.2\cos 2w + 0.5\cos w)$$
Determine the coefficients of the impulse response h(n) of the FIR filter. **(10 Marks)**

b. Obtain a cascade realization for a system described by
$$H(z) = \frac{1 + \frac{1}{4}z^{-1}}{\left(1 + \frac{1}{2}z^{-1}\right)\left(1 + \frac{1}{2}z^{-1} + \frac{1}{4}z^{-2}\right)}.$$ **(06 Marks)**

OR

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

b. Obtain a parallel realization for the transfer function H(z) given below:
$$H(z) = \frac{8z^3 - 4z^2 + 11z - 2}{\left(z - \frac{1}{4}\right)\left(z^2 - z + \frac{1}{2}\right)}.$$ **(06 Marks)**

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