REF. NO. : EX/ PE/PE/H/T/422B

NAME OF THE EXAMINATION: B.E. POWER ENGINEERING FOURTH YEAR SECOND SEMESTER - 2022

SUBJECT: DIGITAL SIGNAL PROCESSING (HONS.)

TIME: 4 HOURS FULL MARKS: 70

Use Separate Answer Sheets for Part A and Part B

PART A

Answer ***Q1*** and ***any SIX (6)*** questions from the rest

1. ***Choose the correct option for any FIVE questions***: (5@1 = 5)

(i) Resolve the following discrete sequence $x(n)$ into a sum of weighted impulse sequences. [CO1]

$x(n) = \{2, 4, 0, 3\}$

a) $2\delta(n)+4\delta(n-1)+3\delta(n-3)$
b) $2\delta(n)+4\delta(n-1)+3\delta(n-2)$
c) $2\delta(n+1)+4\delta(n)+3\delta(n-2)$
d) $2\delta(n-1)+4\delta(n)+3\delta(n-2)$

(ii) If $x(n)$ is a discrete-time signal, then the value of $x(n)$ at non-integer value of 'n' is? [CO1]

a) Zero
b) Not defined
c) Positive
d) Negative

(iii) The amplitude scaling of a sequence $x(n)$ by a factor a is given by [CO2]

a) $y(n) = x(n - a)$
b) $y(n) = ax(n)$
c) $y(n) = a + x(n)$
d) $y(n) = x(an)$

(iv) Determine the value of the summation: [CO1]

$$\sum_{n=-\infty}^{\infty} \delta(n+3)(n^2+n)$$

a) 9
b) 3
c) 6
d) 12

(v) Which one of the following is not a characteristic of a deterministic signal? [CO1]

a) Exhibits no uncertainty
b) Instantaneous value can be accurately predicted
c) Can be represented by a mathematical equation
d) Does not have a non-zero value

(vi) In discrete signal, if $y[n] = x[kn]$ and $k>1$ then _____ [CO3]

a) Some samples are added to x[n]
b) Some samples are lost from x[n]
c) It has no effect on samples
d) Samples will be increased with factor k

(vii) Which of the following is an example for non-causal system? [CO1]

a) $y[n] = \frac{1}{3}\{x[n-1] + x[n] + x[n-2]\}$
b) $y[n] = \frac{1}{2}\{x[n-1] + x[n]\}$
c) $y[n] = \frac{1}{3}\{x[n-1] + x[n] + x[n+1]\}$
d) $y[n] = \frac{1}{2}\{x[n] + x[n-2]\}$

(viii) Find value of the convolution $h[n-1]*\delta[n-1]$, $\delta[n]$ being the impulse sequence. [CO3]

a) h[n]
b) h[n-1]
c) h[n-2]
d) h[n+1]

Answer any SIX (6) Questions

2 (a) What are the advantages and disadvantages of digital signal processing over analog signal processing? (3) [CO1]

(b) Express the signal shown in Fig, 1 as the sum of singular functions and sketch. (2) [CO3]

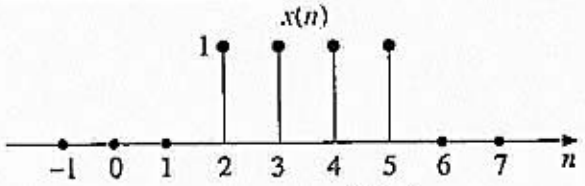

Fig. 1

3. (a) Draw a schematic diagram to explain interrelationship between the basic elements of a Digital Signal Processing System (1) [CO1]

(b) A discrete-time signal $x(n)$ is shown in Fig. 2. Sketch each of the following signals and express them in ***sequence representation form.*** (4) [CO3]

(a) $x(-n)$
(b) $x(n+2)$
(c) $3x(n-2)$
(d) $x(-n+2)$

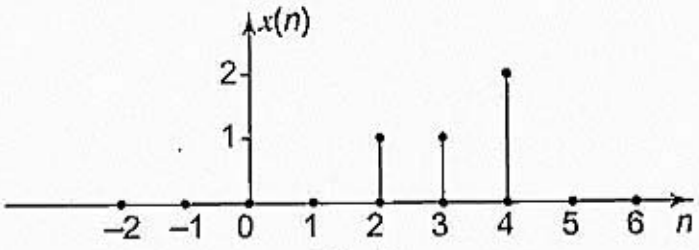

Fig. 2

4 (a) How do you classify a discrete signal as ***"Energy signal"*** or ***"Power signal"***? (2) [CO1]

(b) Check whether the following signals are periodic or not. If the signal is periodic, find its fundamental period. (3) [CO1]

a) $x(n) = e^{j(\pi/4)n}$

b) $x(n) = cos\frac{\pi}{3}n + sin\frac{\pi}{4}n$

5 (a) How do you differentiate between static and dynamic discrete-time systems? (2) [CO1]

(b) Find whether the following systems are causal or not: (6) [CO1]

(a) $y(n) = x(2n)$

(b) $y(n) = \sin[x(n)]$

6 (a) Differentiate between ***memory*** and ***memory-less*** discrete-time systems with relevant examples. (1) [CO1]

(b) Determine if the systems described by the following input-output equations are linear or nonlinear. (4) [CO1]

a) $y(n) = x(n^2)$

b) $y(n) = e^{x(n)}$

7 (a) Justify or rectify the following statement with adequate explanation in relation to discrete-time statement: "***A system is said to be linear if it satisfies superposition principle***" (1) [CO1]

(b) Check whether the following discrete-time systems are BIBO stable or not. (4) [CO1]

(a) $y(n) = ax(n) + b$

(b) $y(n) = ax(n)x(n-1)$

8 (a) What are ***scaling*** and ***distributive*** properties of discrete convolution? (5) [CO1]

(b) Find convolution of the two signals shown ion Fig. 3: (4) [CO2]

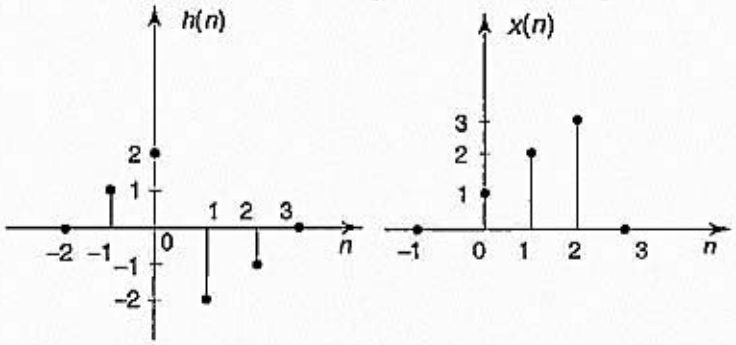

Fig. 3

9 (a) Draw block diagram representation of the system described by the difference equation: (2) [CO1]

$$y(n) = x(n) + 3x(n-1) + 2x(n-2)$$

(b) A DSP system is described by the linear difference equation (3) [CO1]

$$y(n) = 0.2x(n) - 0.5x(n-2) + 0.4x(n-3)$$

Given that the digital input sequence {-1, 1, 0, -1} is applied to this DSP system, determine the corresponding digital output sequence.

PART B

Answer All Questions

1	If $Z\{x(n)\} = X(z)$ prove that $Z\{a^n.x(n)\} = X(z/a)$	(10)	[CO1]
	OR		
	Find the Z-transform of $a^n x(n) + a^{-n}x(n-1)$ and hence derive its ROC, if it exists.	(10)	[CO2]
2.	For a signal $x(t) = 2\sin(wt) + 3\cos\left(3wt + \frac{\pi}{3}\right) + 0.5\sin(4wt + \frac{\pi}{6})$ derive the amplitude and phase spectrum. What should be the minimum sampling frequency if $w = 6.28rad/s$	(8+2)	[CO2]
	OR		
	Derive the amplitude spectrum of a single rectangular pulse of duration 10 sec and height 2V.	(10)	[CO2]
3.	(i) Starting from definition of Fourier Transform of a periodic signal $x(t)$ derive a suitable formulation for the inverse Fourier using $X(w)$	(5)	[CO3]
	(ii) A periodic signal $y(t)$ is passed through a S/H circuit with sampling time T_s to yield $y^*(t)$. If $F\{y(t)\}$ is $Y(w)$, derive $F\{y^*(t)\}$.	(10)	
	OR		
	Calculate the Average Energy/bit for Binary Amplitude Shift Keying (BASK) with 50% depth of modulation for a modulated signal represented by $s_i(t) = A_i Cos(2\pi f_c t + \varphi), 0 \le t \le T_s, i = 1,2$	(15)	[CO3]

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