Q.6 Attempt any two:

i. Write any five features of DSP processors which make them different from general purpose microprocessor. **5**

ii. Explain the Super Harvard Architecture (SHARC) and compare with Von Neumann and Harvard Architecture of DSP Processor. **5**

iii. Describe Instruction Pipelining with a suitable example and diagram. **5**

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Total No. of Questions: 6 *Total No. of Printed Pages:4*

Enrollment No.....

Faculty of Engineering

End Sem Examination Dec-2023

EC3CO06 Digital Signal Processing

Programme: B.Tech. Branch/Specialisation: EC

Duration: 3 Hrs. **Maximum Marks: 60**

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d. Assume suitable data if necessary. Notations and symbols have their usual meaning.

Q.1 i. The Parseval's Relation is: **1**

(a) $\sum_{n=0}^{N-1} x_1(n)x_2^*(n) = \sum_{k=0}^{N-1} X_1(k)\,X_2^*(k)$

(b) $\sum_{n=0}^{N-1} x_1(n)x_2^*(n) = \frac{1}{N}\sum_{k=0}^{N-1} X_1(k)\,X_2^*(k)$

(c) $\sum_{n=0}^{N-1} x_1(n)x_2^*(n) = \frac{1}{N}\sum_{k=0}^{N-1} X_1^*(k)\,X_2(k)$

(d) $\sum_{n=0}^{N-1} x_1(n)x_2^*(n) = \sum_{k=0}^{N-1} X_1^*(k)\,X_2^*(k)$

ii. In DIF radix-2 FFT algorithms: **1**

(a) Output bits are in natural order

(b) Input are bit reversed

(c) Output bits are in bit reversal order.

(d) Both input and output bits are in natural order

iii. Which of the following condition should the unit sample response of a FIR filter satisfy to have a linear phase? **1**

(a) h(M-1-n) n=0,1,2…M-1

(b) ±h(M-1-n) n=0,1,2…M-1

(c) -h(M-1-n) n=0,1,2…M-1

(d) None of these

iv. In the Bilinear Transformation mapping, which of the following are correct? **1**
(a) All points in the LHP of s are mapped outside the unit circle in the z-plane
(b) All points in the RHP of s are mapped inside the unit circle in the z-plane
(c) All points in the RHP of s are mapped on the unit circle in the z-plane
(d) All points in the LHP of s are mapped inside the unit circle in the z-plane

v. Which one is the FIR filter realization method? **1**
(a) Direct Form-II (b) Ladder
(c) Linear Phase (d) All of these

vi. Which structure use Routh's array for realization? **1**
(a) Direct form (b) Cascade
(c) Ladder (d) Linear phase realization

vii. Autocorrelation function and ..... are Fourier transform pair. **1**
(a) PDF (b) PSD (c) CDF (d) Variance

viii. If X and Y are random variable then E(X + Y) is equal to **1**
(a) E(X).E(Y) (b) E(X) + E(Y)
(c) E(X) - E(Y) (d) X +Y

ix. Which architecture has separate cache memory for program instructions? **1**
(a) Von Neumann (b) SHARC
(c) Both (a) and (b) (d) None of these

x. In an ideal case a 3 stage pipelined machine is how many times faster than non-pipelined machine. **1**
(a) 3 (b) 6 (c) 9 (d) None of these

Q.2 i. Write any two properties of twiddle factor. **2**

ii. Find the 4-point circular convolution of the signals: **3**

$$x(n) = \delta(n) + \delta(n-1) + \delta(n-2)$$
$$h(n) = 2u(n) - u(n-2) - u(n-4)$$

iii. If x(n) ={1,0,1,0,1,0,1,0}, Then find the DIT FFT of x(n). **5**

OR iv. Explain Composite Value of 'N' FFT for N=6. **5**

Q.3 i. Explain Frequency Warping Concept. **2**

ii. The transfer function of analog filter is: **3**

$$H(s) = \frac{3}{(s+2)(s+3)}$$

$with\ T_s = 0.1Sec$

Design the Digital IIR filter using BLT

iii. Find the order and poles of a digital filter with following specifications: **5**

$$0.89 \le \left|H(e^{j\omega})\right| \le 1, \qquad 0 \le \omega \le 0.4\pi$$
$$\left|H(e^{j\omega})\right| \le 0.18, \qquad 0.6\pi \le \omega \le \pi$$

Use Impulse Invariance Method.

OR Explain Rectangular Window filter designing technique of FIR filter and Gibb's Phenomenon. **5**

Q.4 Attempt any two:

i. Draw the Transposed Form of the Direct Form-II structure of the given IIR system. **5**

$$H(Z) = \frac{1 - 0.2z^{-1} - 0.6z^{-2}}{1 - 0.5z^{-1} + 0.8z^{-2}}$$

ii. Realize the Ladder structure of the filter **5**

$$H(Z) = \frac{1 + z^{-1} + 6z^{-2}}{1 + 5z^{-1} + 7z^{-2}}$$

iii. For the given FIR filter explain and draw the Linear Phase Structure **5**

$$H(Z) = 1 - 2z^{-1} + 3z^{-2} - 2z^{-3} + z^{-4}$$

Q.5 i. Describe the different statistical averages which are important to describe a random process. **4**

ii. Define Binomial Distribution and if a coin has been tossed for ten times then find out the probability for four times 'Head' will come. **6**

OR iii. Explain any three: **6**
(a) Auto and Cross correlation
(b) Central Limit Theorem
(c) Cumulative Distribution Function
(d) Power Spectral density

Marking Scheme
EC3CO06 Digital Signal Processing

Q.1	i)	B		**1**
	ii)	C		**1**
	iii)	B		**1**
	iv)	D		**1**
	v)	C		**1**
	vi)	C		**1**
	vii)	B		**1**
	viii)	B		**1**
	ix)	B		**1**
	x)	A		**1**
Q.2	i.	Each property one marks		**1 each**
	ii.	Correct value	1 Marks	**1+2**
		Correct calculation and steps	2 Marks	
	iii.	Correct figure	2 Marks	**2+2**
		Correct steps (individual steps)	2 Marks	**+1**
		Final correct answer	1 Marks	
OR	iv.	Correct steps	3 Marks	**3+2**
		Correct diagram	2 Marks	
Q.3	i.	Correct figure	1 Mark	**1 +**
		Explanations	1 Mark	**1**
	ii.	Correct formula	1 Mark	**1 +**
		Correct steps	2 Marks	**2**
	iii.	Frequency conversion	1 Marks	**1+2**
		Correct formulas	2 Marks'	**+2**
		Correct steps	2 Marks	
OR	iv	Correct explanations	2 Marks	**2+1**
		Derivation	1 Mark	**+2**
		Gibb's phenomenon	2 Marks	
Q.4	i.	Direct Form – II structure	2 Marks	**2+3**
		Transposed structure	3 Marks	
	ii.	Correct derivation	3 Marks	**3+2**
		Structure	2 Marks	
	iii.	Correct steps	4 Marks	**4+1**
		Diagram 1 marks		
Q.5	i.	Correct definition	(1 marks each)	

	ii.	Definition	2 Marks	**2+1**
		Formula	1 Mark	**+3**
		Correct steps 3 marks	3 Marks	
OR	iii.	Each correct definition	2 marks	

Q.6

	i.	Each correct feature (**1 marks each)**	
	ii.	Definition	2 Marks
		Comparison with each marks	(1.5+1.5)
	iii.	Description	2 Marks
		Example	2 Marks
		Diagram	1 Mark

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