Q.6		Attempt any two:					
	i.	Explain the addressing formats and functional modes of a DSP processor.	**5**	01	01	01	01
	ii.	Explain about any one application of DSP processor.	**5**	02	01	04	01
	iii.	Explain the architecture of TMS320C67 with block diagram.	**5**	02	01	01	01

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

Enrollment No.....

Faculty of Engineering

End Sem Examination Dec 2024

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.

			Marks	BL	PO	CO	PSO
Q.1	i.	If x(n) and X(k) are an N point DFT pair, then X(k+N) will be- (a) X(-k) (b) -X(k) (c) X(k) (d) $X(k)^2$	**1**	01	01	01	01
	ii.	If $X_1(k)$ $X_1(k)$ and $X_2(k)$ $X_2(k)$ are the N-point DFT of $x_1(n)$ and $x_2(n)$ respectively, then what is the N-point DFT of $x(n) = ax_1(n) + bx_2(n)$- (a) $X_1(ak) + X_2(ak)$ (b) $aX_1(k) + bX_2(k)$ (c) $bX_1(k) + aX_2(k)$ (d) None of these	**1**	01	01	01	01
	iii.	Which of the following substitution is done in Bilinear transformations? (a) $S = \frac{2}{T}\left[\frac{1-Z^{-1}}{1+Z^{-1}}\right]$ (b) $S = \frac{2}{T}\left[\frac{1+2Z^{-1}}{1+Z^{-1}}\right]$ (c) $S = \frac{2}{T}\left[\frac{1-2Z^{-1}}{1+Z^{-1}}\right]$ (d) None of these	**1**	01	01	01	01
	iv.	What is the width of the main lobe of the frequency response of a rectangular window of length M-1? (a) π/M (b) $4\pi/M$ (c) $8\pi/M$ (d) None of these	**1**	01	01	01	01

v.	Which of the following is a method for implementing an FIR system? (a) Direct form (b) Cascade form (c) Lattice structure (d) All of these	**1**	01	01	01	01
vi.	Limit cycles in the recursive structures are directly attributable to which of the following- (a) Round off errors in multiplication (b) Overflow errors in addition (c) Both (a) and (b) (d) None of these	**1**	01	01	01	01
vii.	The random variables X and Y have variances 0.2 and 0.5 respectively. If Z=5X-2Y then find variance of Z- (a) 3 (b) 10 (c) 9 (d) 7	**1**	02	02	01	01
viii.	The variance of a random variable X, Var(X) is defined by- (a) $Var(X) = E(X^2) - \{E(X)\}^2$ (b) $Var(X) = E(X) - \{E(X^2)\}$ (c) $Var(X) = E(X^2) - \{E(X)\}$ (d) None of these	**1**	01	01	01	01
ix.	Digital signal processor requires- (a) Serial execution (b) Parallel execution (c) Both (a) and (b) (d) None of these	**1**	01	01	01	01
x.	Which of the following conditions made digital signal processing more advantageous over analog signal processing? (a) Flexibility (b) Accuracy (c) Storage (d) All of these	**1**	01	01	01	01
Q.2 i.	Define the term FFT.	**2**	01	01	01	01
ii.	Write properties of DFT.	**3**	01	01	01	01
iii.	Calculate DFT for the sequence- $x(n) = \{1,1,0,0\}$	**5**	02	02	02	01
OR iv.	Find circular convolution of the sequences- $x_1(n) = \{2,1,2,1\}$ and $x_2(n) = \{1,2,3,4\}$	**5**	03	02	01	02

Q.3 i.	Explain hamming window function with time & frequency domain representation.	**3**	01	01	01	01
ii.	Design a Butterworth filter method using Bilinear transformation for the following specifications- $0.8 \le \left\|He^{j\omega}\right\| \le 1, \quad 0 \le \omega \le 0.2\pi$ $\left\|He^{j\omega}\right\| \le 0.2, \quad 0.6\pi \le \omega \le \pi$	**7**	02	02	01	01
OR iii.	Convert the analog filter with system function H(s) into digital IIR filter by means of impulse invariant method- $H(s) = \frac{1}{(S+0.2)(S+0.6)}$	**7**	03	02	03	02
Q.4	Attempt any two:					
i.	Evaluate the Direct Form I, Direct Form II for the following system- $y(n) = 0.75y(n-1) - 0.125y(n-2) + 3x(n) + 7x(n-1) + x(n-2)$	**5**	03	03	03	03
ii.	Realize a cascade and parallel realization for the system having difference equation- $y(n) + 0.1y(n-1) - 0.2y(n-2) = 3x(n) + 3.6x(n-1) + 0.6x(n-2)$	**5**	03	01	04	02
iii.	Explain lattice & lattice-ladder structure for IIR digital filter.	**5**	01	01	01	01
Q.5 i.	Explain central limit theorem.	**3**	01	01	01	01
ii.	Let X be a discrete random variable with PMF- $P_X(x) = \begin{cases} \frac{1}{3}, & x = 0 \\ \frac{2}{3}, & x = 2 \end{cases}$ Find the following- (a) The expected value of random variable X (b) Variance of random variable X	**7**	02	01	02	01
OR iii.	Find the power spectral density of a random sequence X[n] whose autocorrelation function is given by $R_{XX}[m] = a^{\lvert m \rvert}$.	**7**	03	01	04	01

Marking Scheme
EC3CO06 (T) Digital Signal Processing (T)

Q.1 i) c) X(k) **1**

ii) b) $aX_1(k) + bX_2(k)$ **1**

iii) $a)\ S = \frac{2}{T}\left[\frac{1 - Z^{-1}}{1 + Z^{-1}}\right]$ **1**

iv) b) $4\pi/M$ **1**

v) d) All of the above **1**

vi) c) Both a and b **1**

vii) d) 7 **1**

viii) a) Var(X) = $E(X^2)$ - $\{E(X)\}^2$ **1**

ix) b) Parallel Execution **1**

x) d) All of the above **1**

Q.2 i. Define the term FFT. **2**

ii. Write properties of DFT. (Each property-1 mark) **3**

iii. Calculate DFT for the sequence **5**
$x(n) = \{1,1,0,0\}$.
Farmula-2 marks
Method-3 Marks

OR iv. Find circular convolution of the sequences $x_1(n) = \{2,1,2,1\}$ and $x_2(n) = \{1,2,3,4\}$. **Each step 1 mark** **5**

Q.3 i. What is Hamming window function? **3**
Formula-2 marks Define-1 mark

ii. Design a Butterworth filter method using Bilinear transformation for the following specifications **7**

$$0.8 \le \left|He^{j\omega}\right| \le 1, \quad 0 \le \omega \le 0.2\pi$$
$$\left|He^{j\omega}\right| \le 0.2, \quad 0.6\pi \le \omega \le \pi$$

Step marking

OR iii. Convert the analog filter with system function H(s) into digital IIR filter by means of impulse invariant method **7**

$$H(s) = \frac{1}{(S + 0.2)(S + 0.6)}$$

Step marking

Q.4 Attempt any two:

i. Evaluate the Direct Form I, Direct Form II for the following system **5**
$y(n) = 0.75y(n-1) - 0.125y(n-2) + 3x(n) + 7x(n-1) + x(n-2)$
2.5 marks each

ii. Realize a casecade and parallel realization for the system having difference equation **5**
$y(n) + 0.1y(n-1) - 0.2y(n-2) = 3x(n) + 3.6x(n-1) + 0.6x(n-2)$
2.5 marks each

OR iii. Explain lattice & lattice-ladder structure for IIR digital filter. **5**
2.5 marks each

Q.5 i. Explain central limit theorem. **3**
Graph – 1 marks
Theory- 2 marks

ii. Let X be a discrete random variable with PMF **7**

$$P_X(x) = \begin{cases} \frac{1}{3}, & x = 0 \\ \frac{2}{3}, & x = 2 \end{cases}$$

Find

a) The expected value of random variable X- 3 mark
b) Variance of random variable X- 4 mark

P.T.O.

3.5 marks each

OR iii. Find the power spectral density of a random sequence X[n] whose autocorrelation function is given by $R_{XX}[m] = a^{|m|}$. **7**

Step marking

Q.6 Attempt any two:

i. Explain the addressing formats and functional modes of a DSP Processor. (explanation addressing mode-2.5 mark, functional mode-2.5 marks) **5**

2.5 marks each

ii. Explain about any one application of DSP Processor. **5**

iii. Explain the architecture of TMS320C67 with block diagram. **(diagram – 3 marks , explanation-2 marks)** **5**

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