Total No. of Questions: 6 *Total No. of Printed Pages:3*

Enrollment No.....

Faculty of Engineering

End Sem Examination May-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. Which transform has only real values? **1**

(a) Discrete Fourier Transform (b) Z-Transform

(c) Discrete Cosine Transform (d) None of these

ii. The value of twiddle factor W_N is- **1**

(a) $e^{-j2\pi N}$ (b) $e^{-j2\frac{\pi}{N}}$ (c) $e^{-j2\pi}$ (d) $e^{j2\frac{\pi}{N}}$

iii. Which of the following is not an IIR digital filter design method? **1**

(a) Bilinear Transform (b) Impulse invariant

(c) Approximation of Derivative (d) Windowing

iv. In the bilinear transformation, relationship between ω and Ω is- **1**

(a) $\Omega = 2tan\frac{\omega}{2}$ (b) $\Omega = \frac{2}{T}tan\frac{\omega}{2}$

(c) $\Omega = \frac{1}{T}tan\frac{\omega}{2}$ (d) $\Omega = tan\frac{\omega T}{2}$

v. The structure which uses less number of delay elements is- **1**

(a) Direct form-I (b) Direct form-II

(c) Cascade form (d) Parallel form

vi. The number of multipliers required for the realization of FIR systems is reduced if we choose- **1**

(a) Direct form (b) Cascade form

(c) Parallel form (d) Linear Phase realization

vii. The problem of losing accuracy because of limited number of bits in representation of numbers on digital hardware is- **1**

(a) Quantisation (b) Overflow (c) Round off (d) None of these

P.T.O.

viii. Which Probability distribution function is not for discrete? **1**

(a) Binomial Distribution (b) Normal Distribution

(c) Poisson Distribution (d) All of these

ix. The pipelining refers to- **1**

(a) Prefetching instructions and storing in a FIFO queue

(b) Fetching instructions and data simultaneously

(c) Executing different phases of two or more instructions in parallel

(d) None of these

x. Which is the architectural feature of DSP Processor? **1**

(a) Separate memory for program and data

(b) Specialized instruction set

(c) Pipelining

(d) All of these

Q.2 i. State and prove Periodicity Property of DFT. **2**

ii. The first five points of the 8-point DFT of a real – valued sequence are **3**

$\{0.05, 0.1 - j, 0.3, 0.1 + j, 0.05\}$.

Determine the remaining three points.

iii. If $x_1(n)$ and $x_2(n)$ are N point sequences with $X_1(k)$ and $X_2(k)$ are DFTs **5**

show that

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

OR iv. Compute the 4-points circular convolution of- **5**

$x_1(n) = \{1, 1, 0, 0\}$ and

$x_2(n) = \text{Sin}\,(3\pi n/8), \quad 0 \le n \le 3$

Q.3 i. Explain Gibb's Phenomenon. **2**

ii. Design a normalized Butterworth digital low-pass filter using bilinear transformation. The specifications of the desired filter are- **8**

$$0.9 \le |H(\omega)| \le 1; 0 \le \omega \le \frac{\pi}{2}$$

$$|H(\omega)| \le 0.2; \frac{3\pi}{4} \le \omega \le \pi$$

with T = 1 sec.

OR iii. By using frequency sampling approach determine the impulse response h(n) of an FIR filter. It is given that the length of the filter is M=7 and cut off frequency $\omega_c = \pi/2$. **8**

Q.4 i. Define Quantization, round-off and overflow error in digital filters. **3**

ii. Realize and draw the structure for the following transfer function using parallel form. **7**

H(z)=(3+1.25z-1)/(1+0.75z-1+0.125z-2)

OR iii. Realize the following system with linear phase realization- **7**

$$H(z) = \frac{1}{3} + \frac{z^{-1}}{5} + \frac{2z^{-2}}{3} + \frac{z^{-3}}{5} + \frac{z^{-4}}{3}$$

Q.5 i. Define central limit theorem for random process. **4**

ii. If X and Y are two random variables then prove the following properties of covariance: **6**

(a) Cov(X, X) = Var(X)

(b) Cov(aX, bY) = abCov(X, Y)

(c) Cov(X+a, Y+b) = Cov(X, Y)

OR iii. If the probability that an individual suffer a bad reaction from a certain injection is 0.001 then by using Poisson distribution determine the probability that out of 2000 individuals (a) exact 3 and (b) more than 2 individuals will suffer a bad reaction. **6**

Q.6 Attempt any two:

i. Write any 5 properties of DSP processor. **5**

ii. What is instruction pipelining? Briefly explain the pipeline operation. **5**

iii. Compare fixed-point and floating-point processor. **5**

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Marking Scheme

EC3CO06 [T] Digital Signal Processing

Q.1	i)	C	**1**
	ii)	B	**1**
	iii)	D	**1**
	iv)	B	**1**
	v)	B	**1**
	vi)	D	**1**
	vii)	B	**1**
	viii)	B	**1**
	ix)	C	**1**
	x)	D	**1**
Q.2	i.	Definition and proof	**1Mark each**
	ii.	Write derivation	**3 Marks**
	iii.	Correct derivation	**5**
OR	iv.	Each write steps	**1 Marks each**
Q.3	i.	Write Explanation	**2 marks**
	ii.	Correct Steps and answer	**2 Marks each**
OR	iii.	Correct Steps and answer	**2 Marks each**
Q.4	i.	Correct definitions	**1 Mark each**
	ii.	Correct Steps and answer	**2 Marks each and 1 Mark**
OR	iii.	Correct Steps and answer	**2 Marks each and 1 Mark**
Q.5	i.	Correct definitions and explanation	**2 marks each**
	ii.	Each property	**2 Marks each**
OR	iii.	Correct solution of each part	**3 Marks each**
Q.6			
	i.	Correct properties	**1 Mark each**
	ii.	Correct definitions and explanation	**2.5 Marks each**
	iii.	Correct comparison	**Each 1 mark**

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