Enrollment No......................................

Faculty of Engineering
End Sem (Even) Examination May-2022
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.

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 circular convolution of two sequences in time domain is   **1**
            equivalent to-
            (a) Multiplication of DFTs of two sequences
            (b) Summation of DFTs of two sequences
            (c) Difference of DFTs of two sequences
            (d) Square of multiplication of DFTs of two sequences

      iii.   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) $\Omega = tan\frac{\omega T}{2}$

      iv.   If M is odd samples then what is the value of h{(M-1)/2} if the unit   **1**
            sample response is anti-symmetric?
            (a) 0   (b) 1   (c) -1   (d) None of these

      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   **1**
            systems is reduced if we choose-
            (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

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. Briefly compare Goertzel algorithm with DFT. **4**
ii. Explain these properties of DFT **6**
(a) Parseval's Theorem   (b) Symmetry
OR   iii. Define the FFT algorithm for composite value of 'N' with the example of N = 6. **6**

Q. 3   i. Explain the rectangular window for filter designing. **4**
ii. Design a normalized Butterworth digital low-pass filter using bilinear transformation. The specifications of the desired filter are: **6**

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

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

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 $\omega_c = \pi /2$. **6**

Q.4   Attempt any two:
i. Realize and draw the structure for the following transfer function using cascaded bilinear terms. **5**

$$\frac{1 + 3z^{-1} + 2z^{-2}}{1 + \frac{3}{4}z^{-1} + \frac{1}{8}z^{-2}}$$

ii. Realize the IIR filter $H(z) = \frac{3z^2 + 5z + 4}{z^2 + 6z + 8}$ using lattice structure. **5**

iii. Realize the following system with linear phase realization: **5**

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

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 **6**
(a) Exact 3
(b) More than 2 individuals will suffer a bad reaction.

Q. 6   Attempt any two:
i. Give any five advantages of DSP processor over conventional microprocessor. **5**
ii. What is instruction pipelining? Briefly explain the pipeline operation. **5**
iii. Compare fixed and floating point processor. **5**

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

iv. If M is odd samples then what is the value of $h\{(M-1)/2\}$ if the unit   **1**
sample response is anti-symmetric?
(a) 0

v. The structure which uses less number of delay elements is-   **1**
(b) Direct form-II

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

vii. The problem of losing accuracy because of limited number of bits   **1**
in representation of numbers on digital hardware is-
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viii. Which Probability distribution function is not for discrete?   **1**
(b) Normal Distribution

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

x. Which is the architectural feature of DSP Processor?   **1**
(d) All of these

Q.2 i. Each Comparisons.   1 Mark*4   **4**

ii. (a) Parseval's Theorem   3 Marks   **6**
(b) Symmetry   3 Marks

OR iii. Derivation   4 Marks   **6**
Diagram   2 Marks

Q. 3 i. Definition   2 Marks   **4**

Derivation   2 Marks

ii. Conversion/ Derivation   4 Marks   **6**
Write formula of bilinear   1 Mark
Correct Answer   1 Mark

OR iii. Correct Formula   1 Mark   **6**
Derivation   4 Marks
Correct Answer   1 Mark

Q.4   Attempt any two:
i. Correct Derivation   3 Marks   **5**
Diagram   2 Marks
ii. Correct Derivation   3 Marks   **5**
Diagram   2 Marks
iii. Correct Derivation   3 Marks   **5**
Diagram   2 Marks

Q.5 i. Correct Definition with example   4 Marks   **4**

ii. Each Property   (2 Marks*3)   **6**
OR iii. Correct Formula   2 Marks   **6**
Correct answer of part (a)   2 Marks
Correct answer of part (b)   2 Marks

Q. 6   Attempt any two:
i. Each advantage   (1   **5**
Marks*5)
ii. Definition   2 Marks   **5**
Pipeline Operation   3 Marks
iii. Each Comparison.   1 Mark*5   **5**

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