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

Faculty of Engineering

End Sem (Even) Examination May-2022

EE3EL03/ EX3EL03 Digital Signal Processing

Programme: B.Tech.   Branch/Specialisation: EE/EX

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 of the following discrete time system is a linear system?   **1**
(a) $y[n] = nx[n]$ (b) $y[n] = x^2[n]$
(c) $y[n] = ax[n] + b$ (d) $y[n] = x[n][1 + cos\omega n]$

   ii.   If the length of two discrete time signal is given as L_1 & L_2 **1**
respectively, then the length of convolution result of the two signals will be-
(a) $L_1 + L_2$ (b) $L_1 + L_2 + 1$
(c) $L_1 + L_2 - 1$ (d) $L_1 - L_2$

  iii.   The Region of Convergence (ROC) of the Z transform of a Unit step   **1**
function is-
(a) |Z| >1   (b) |Z| < 1
(c) Real part of Z > 0   (d) Real part of Z < 0

  iv.   The Region of Convergence (ROC) of the Z-transform of the   **1**
sequence $(\frac{5}{6})^n u[n] - (\frac{6}{5})^n u[-n - 1]$
(a) $|z| < \frac{5}{6}$ (b) $|z| > \frac{5}{6}$
(c) $\frac{5}{6} < |z| < \frac{5}{6}$ (d) $\frac{5}{6} < |z| < \infty$

  v.   In a Fourier series expansion of a signal, coefficient a_n would be   **1**
zero when the nature of the signal is _____.
(a) Even   (b) Odd
(c) Half wave symmetrical   (d) None of these

  vi.   For an Analog LTI system to be stable, where should the poles of   **1**
system function H(s) lie?
(a) Right half of s-plane   (b) Left half of s-plane
(c) On the imaginary axis   (d) At origin

                                                       P.T.O.

vii. DFT is applied to- **1**
   (a) Infinite sequences
   (b) Finite discrete sequences
   (c) Continuous infinite signals
   (d) Continuous finite sequences

viii. DFT of _____ sequence results in a _____ sequence. **1**
   (a) Finite length, aperiodic   (b) Infinite length, aperiodic
   (c) Finite length, periodic   (d) Infinite length, periodic

ix. Which of the following methods are used to convert analog filter into digital filter? **1**
   (a) Approximation of derivatives
   (b) Bilinear transformation
   (c) Impulse invariance
   (d) All of these

x. If z transform is evaluated for the unit circle at evenly spaced points only then it becomes- **1**
   (a) IIR filters   (b) DFT   (c) IDFT   (d) FIR filters

Q.2 i. Define and classify systems. **2**
   ii. Draw and explain the graphical representation of discrete time signal. **3**
   iii. Examine the following system with respect to the properties- Linearity, Time-Variance, Causality and Stability. **5**
   (a) $y(n) = x(-n + 2)$ (b) $y(n) = x(2n)$
   (c) $y(n) = \sum_{k=-\infty}^{n} x(k)$

OR iv. State and prove the following properties of DTFT- **5**
   (a) Multiplication of two sequence
   (b) Differentiation in the frequency domain

Q.3 i. Define Z transform and region of convergence (ROC) for the Z transform. **3**
   ii. Consider the linear constant coefficient difference equation- **7**
   $$y(n) = 0.25y(n - 2) + x(n)$$
   Find the solution to this equation assuming that $x(n) = \delta(n - 1)$ with $y(-1) = y(-2) = 1$.

OR iii. Explain and prove following properties of Z transform- **7**
   (a) Time reversal   (b) Convolution

Q.4 Attempt any two:
   i. Enlist the difference between a continuous time Fourier transform and a discrete time Fourier transform. **5**
   ii. What are the advantages of Digital signal processing over Analog signal processing? **5**
   iii. Determine the circular convolution of the following sequences- **5**
   $$x_1(n) = \{2,1,2,1\}, \quad and \quad x_2(n) = \{1,2,3,4\}$$

Q.5 i. Explain the circular property of DFT with example. **3**
   ii. Draw the flow graph for decimation-in-time FFT algorithm for N = 8 using radix-2. Show various steps for decimation. **7**

OR iii. Compute the eight-point DFT of the following- **7**
   $$x(n) = [1,2,3,4,5,6,7,8]$$

Q.6 i. What are the desirable and undesirable features of FIR filters? Differentiate between FIR filters and IIR filters. **4**
   ii. Realize the FIR filter transfer function $H(z) = (1 + 0.4Z^{-1})^4$ in **6**
   (a) Cascade of first order section
   (b) Two different direct forms

OR iii. Explain the procedure for designing FIR filter using windows. **6**

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Q.1   i.   Which of the following discrete time system is a linear system?   **1**

(a) $y[n] = nx[n]$

ii.   If the length of two discrete time signal is given as L_1 & L_2 **1** respectively, then the length of convolution result of the two signals will be-

(c) $L_1 + L_2 - 1$

iii.   The Region of Convergence (ROC) of the Z transform of a Unit step   **1** function is-

(a) $|Z| > 1$

iv.   The Region of Convergence (ROC) of the Z-transform of the   **1** sequence $(\frac{5}{6})^n u[n] - (\frac{6}{5})^n u[-n-1]$

(c) $\frac{5}{6} < |z| < \frac{5}{6}$ (d) $\frac{5}{6} < |z| < \infty$

v.   In a Fourier series expansion of a signal, coefficient a_n would be   **1** zero when the nature of the signal is _____.

(b) Odd

vi.   For an Analog LTI system to be stable, where should the poles of   **1** system function H(s) lie?

(b) Left half of s-plane

vii.   DFT is applied to-   **1**

(b) Finite discrete sequences

viii.   DFT of _____ sequence results in a _____ sequence.   **1**

(d) Infinite length, periodic

ix.   Which of the following methods are used to convert analog filter   **1** into digital filter?

(d) All of these

x.   If z transform is evaluated for the unit circle at evenly spaced points   **1** only then it becomes-

(b) DFT

Q.2   i.   Definition   1 mark   **2**

      Classify systems   1 mark

ii.   Graphical representation of discrete time signal   **3**

      Drawing   1 mark

      Explanation   2 marks

iii.   (a) $y(n) = x(-n+2)$ 1 mark   **5**

      (b) $y(n) = x(2n)$ 2 marks

      (c) $y(n) = \sum_{k=-\infty}^{n} x(k)$ 2 marks

OR   iv.   State and prove the following properties of DTFT-   **5**

      (a) Multiplication of two sequence

      Statement   1 mark

      Prove   1.5 marks

      (b) Differentiation in the frequency domain

      Statement   1 mark

      Prove   1.5 marks

Q.3   i.   Definition Z transform   1 mark   **3**

      Region of convergence (ROC) for the Z transform   2 marks

ii.   Find the solution   **7**

      Stepwise solution, 1 mark for each step   (1 mark * 7)

OR   iii.   (a) Time reversal Explanation   1.5 marks   **7**

      Prove   1 mark

      (b) Convolution Explanation   1.5 marks

      Prove   1 mark

Q.4   Attempt any two:

i.   Difference between a continuous time Fourier transform and a   **5** discrete time Fourier transform.

      1 mark for each difference   (1 mark * 5)

ii.   Advantages of Digital signal processing over Analog signal   **5** processing

      1 mark for each advantage   (1 mark * 5)

iii.   Determine the circular convolution of the following sequences-   **5**

      Stepwise solution

Q.5   i.   Circular property of DFT   2 marks   **3**

      Example   1 mark

ii.   Flow graph for decimation-in-time FFT algorithm   **7**

      Diagram   3 marks

      Stepwise solution   4 marks

OR   iii.   Compute the eight-point DFT of the following-   **7**

      Stepwise solution

Q.6   i.   Four desirable features of FIR filters   **4**
              0.5 mark for each (0.5 mark * 4)   2 marks
              Undesirable features of FIR filters
              0.5 mark for each (0.5 mark * 4)   2 marks
       ii.   Realize the FIR filter transfer function $H(z) = (1 + 0.4Z^{-1})^4$ in   **6**
              (a) Cascade of first order section   3 marks
              (b) Two different direct forms   3 marks
OR   iii.   Procedure for designing FIR filter using windows   **6**
              1 mark for each procedure   (1 mark * 6)

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