DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE

Supplementary Summer Examination – 2023

Course: B. Tech.

Branch: Electronics & Telecommunication Engineering/Electronics &Communication Engineering/Electronics Engineering

Subject Code & Name: BTETC502/BTEXC502 Digital Signal Processing

Semester: V **Max Marks: 60** **Date: 09-08-2023** **Duration: 3 Hr.**

Instructions to the Students:

1. *All the questions are compulsory.*
2. *The level of question/expected answer as per OBE or the Course Outcome (CO) on which the question is based is mentioned in ( ) in front of the question.*
3. *Use of non-programmable scientific calculators is allowed.*
4. *Assume suitable data wherever necessary and mention it clearly.*

		(Level/CO)	Marks
Q. 1	**Solve Any Two of the following.**		**12**
A)	Show that **a)** $r(n) = \sum_{k=0}^{\infty} k\, \delta(n-k)$ **b)** $r(n) = \sum_{k=-\infty}^{n-1} u(k) = \sum_{m=1}^{\infty} u(n-m)$	**(L1/CO1)**	**6**
B)	Write any 6 properties of Discrete Time Fourier Transform.	**(L1/CO2)**	**6**
C)	Find the energy of sequence $x(n) = sinc\, \frac{\omega_c n}{\pi}$	**(L1/CO1)**	**6**
Q.2	**Solve Any Two of the following.**		**12**
A)	Find the Fourier transform of given signals. Also plot magnitude and phase. **a)** $x(n) = \delta(n)$ **b)** $x(n) = a^n\, u(n)$	**(L2/CO2)**	**6**
B)	**a)** Compute the 4-point DFT of $x(n) = (-1)^n$ ….. $0 \le n \le 3$ using matrix method. **b)** Perform linear convolution using circular convolution of given signals. $x(n) = \{2, 5, 0, 4\}$, $h(n) = \{4, 1, 3\}$	**(L3/CO1)**	**6**
C)	Given $x(n) = \{1, 0, -1, 0, 1, 0, -1, 0\}$. Find X(k) using DIT-FFT algorithm.	**(L3/CO4)**	**6**
Q. 3	**Solve Any Two of the following.**		**12**
A)	Find the inverse z-transform using partial fraction method for given signal. Also plot the ROC with locations of poles that you calculated. $X(Z) = \frac{1}{(1-1.5Z^{-1}+0.5Z^{-2})}$ if a) ROC: $\|z\| > 1$ b) ROC: $\|z\| < 0.5$	**(L2/CO2)**	**6**

B) Use initial value theorem to find the initial value of the signals. **(L3/CO1)** **6**

a) $X(Z) = \frac{2+Z^{-1}}{(1-Z^{-1})(1+0.5\,Z^{-1})}$

b) $X(Z) = \frac{1-3\,Z^{-1}}{(1-0.1\,Z^{-1})(1+0.6\,Z^{-1})}$

C) Determine the Z-transform of given signal. Depict ROC and locations of poles and zeros in Z plane. **(L3/CO4)** **6**

$x(n) = n(\frac{1}{2})^{|n|}$

Q.4 Solve Any Two of the following. **12**

A) Differentiate between Finite Impulse Response (FIR) filter and Infinite Impulse Response (IIR) filter. **(L2/CO2)** **6**

B) Transform the analog filter transfer function into digital filter $H(Z)$ using Impulse Invariant Method **(L3/CO1)** **6**

$$H_a(S) = \frac{0.5(S+4)}{(S+1)(S+2)}$$

C) For transfer function $H(S)$ find $H(Z)$ using Bilinear transformation method. Assume T=1. **(L2/CO2)** **6**

$$H(S) = \frac{1}{(S^2 + \sqrt{2}S + 1)}$$

Q. 5 Solve Any Two of the following. **12**

A) Explain the design method for a low pass Butterworth filter using a bilinear transformation. Given **(L3/CO2)** **6**

$$\delta_1 \leq H(e^{jw}) \leq 1 \quad 0 \leq |\omega| \leq \omega_p$$
$$|H(e^{jw})| \leq \delta_2 \quad \omega_s \leq |\omega| \leq \pi$$

B) Find the filter order N and cut-off frequency Ω_c for an IIR low pass Butterworth filter using Bilinear transformation. The filter specifications are as follows: **(L2/CO4)** **6**

Passband: $0.8 \leq \left|H\left(e^{j\omega}\right)\right| \leq 1 \qquad |\omega| \leq 0.2\pi$
Stopband: $\left|H(e^{j\omega})\right| \leq 0.2 \qquad 0.6\pi \leq |\omega| \leq \pi$
Assume T=1 $second$.

C) Consider the following LTI system with system function and draw the direct form I and direct form II structure **(L2/CO2)** **6**

a) $H(Z) = 1 - \frac{1}{3}Z^{-1} + \frac{1}{6}Z^{-2} + Z^{-3}$

b) $H(Z) = \frac{1+2Z^{-1}-Z^{-2}}{1+Z^{-1}-Z^{-2}}$

***** End *****