DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE – RAIGAD -402 103
Regular & Supplementary Winter Examination-2023

Branch: Electronics/Electronics and Telecommunication Engineering/Electronics and Communication
Sem.:- V **Course: B. Tech**
Marks: 60
Subject with Subject Code: - BTEXC502/BTETC502 Digital Signal Processing
Date:- 3/1/2024(2 to 5 pm) **Time: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)	State and prove sampling theorem for low pass signals with neat diagram. Also explain the term aliasing.	L2	6
B)	A C.T. signal x(t) is obtained at the output of an ideal low pass filter with cut-off frequency $w_c = 1000\pi$ rad/sec. If instantaneous sampling is performed on x(t), which of the following sampling period would guarantee that x(t) can be recovered from its sampled version using an appropriate low pass filter. 1) $T_s = 0.5 \times 10^{-3}$ 2) $T_s = 2 \times 10^{-3}$ 3) $T_s = 10^{-4}$	L3	6
C)	Write the applications of Digital Signal Processing.	L1	6
Q.2	**Solve Any Two of the following.**		**12**
A)	State and prove the following properties of DTFT: 1) Frequency shifting 2) Time shifting 3) Differentiation in frequency 4) Time convolution	L1	6
B)	Determine and sketch the magnitude and phase response of y(n): y(n) = 0.5{x(n)+ x(n-2)}	L2	6
C)	Determine N-point IDFT of X(k) = δ(k), 0 ≤ k ≤ N-1 and for $0 \le k_0 \le N-1$, determine the DFT of using the previous result. 1) $x_1(n) = e^{j\frac{2\pi}{N}k_0 n}$ 2) $x_2(n) = e^{-j\frac{2\pi}{N}k_0 n}$ 3) $x_3(n) = \cos\left(\frac{2\pi}{N}k_0 n\right)$ 4) $x_4(n) = \sin\left(\frac{2\pi}{N}k_0 n\right)$	L2	6

Q. 3	**Solve Any Two of the following.**		**12**
A)	Find the linear convolution of the following two signals using overlap and save method. $x(n) = \{3, -1, 0, 1, 3, 2, 0, 3, 2, 2\}$ and $h(n) = \{1, 1, 1\}$	L2	6
B)	Complete the convolution of the convolution property of Z-Transform. $x_1(n) = \{1, -2, 1\}$, $0 \le n \le 2$ and $x_2(n) = \{1, 1, 1, 1, 1, 1\}$, $0 \le n \le 5$	L2	6
C)	Determine the Z.T. and ROC of the following finite duration signals: (a) $x[n] = \{1, 2, \mathbf{3}, -1, 0, 1\}$, $-2 \le n \le 3$ (b) $x[n] = \{\mathbf{0}, 0, 1, 2, 1\}$, $0 \le n \le 4$ (c) $x[n] = \{1, 2, 3, -1, \mathbf{0}\}$, $-4 \le n \le 0$	L1	6
Q.4	**Solve Any Two of the following.**		**12**
A)	Design a simple Low Pass FIR digital filter. Plot its pole zero plot. Obtain and plot magnitude and phase response for the same.	L3	6
B)	Derive the expression to obtain the order of a Butterworth filter.	L1	6
C)	Derive expression of y(n) and draw the direct form and its transposed structure of the transfer function given by $H(z) = 1 - (1/3)z^{-1} + (1/6)z^{-2} + z^{-3}$.	L2	6
Q. 5	**Solve Any Two of the following.**		**12**
A)	Explain the indirect method of designing digital filters from analog filters. Also differentiate between digital filters and analog filters.	L1	6
B)	Explain Aliasing effect in downsampling with the help of neat diagrams. Explain to the process to prevent this effect.	L2	6
C)	For the transfer function $H(s) = \frac{1}{s^2 + \sqrt{2}s + 1}$ Find the corresponding system function H(z) using bilinear transformation algorithm. Assume T=1.	L3	6

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