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Brainware University  
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## BRAINWARE UNIVERSITY

Term End Examination 2024-2025

Programme – M.Tech.(RA)-2023

Course Name – Signal Processing in Mechatronic System

Course Code - PEC-MIRA301A

( Semester III )

Full Marks : 60

Time : 2:30 Hours

[The figure in the margin indicates full marks. Candidates are required to give their answers in their own words as far as practicable.]

### Group-A

(Multiple Choice Type Question)

1 x 15=15

1. Choose the correct alternative from the following :

- (i) Select sequence in signal processing?
  - a) A continuous signal
  - b) A finite set of numbers in a specific order
  - c) An impulse function
  - d) None of the above
- (ii) Tell that which of the following is NOT an example of a discrete sequence
  - a) [1, 2, 3, 4, 5]
  - b) Sinusoidal signal
  - c) [0, 0, 1, 0, 0]
  - d) [1, 2, 4, 8, 16]
- (iii) Nyquist theorem relates to
  - a) Sampling theorem
  - b) Fourier transform
  - c) Signal quantization
  - d) Time-domain analysis
- (iv) In signal processing, estimate the term for the process of converting a digital signal back into an analog signal.
  - a) Sampling
  - b) Reconstruction
  - c) Quantization
  - d) Modulation
- (v) Select a sampling techniques that is commonly used in audio signal processin.
  - a) Pulse Amplitude Modulation (PAM)
  - b) Pulse Code Modulation (PCM)
  - c) Pulse Width Modulation (PWM)
  - d) Frequency Modulation (FM)
- (vi) Select a correct statement about the sampling theorem
  - a) It states that a signal must be sampled at a rate equal to its Nyquist frequency to avoid distortion.
  - b) It guarantees perfect reconstruction of a continuous signal from its samples.
  - c) It allows for infinite over-sampling without any adverse effects.
  - d) It applies only to periodic signals.
- (vii) Indicate the use of Z-Transform in signal processing
  - a) Time-domain analysis
  - b) Frequency-domain analysis
  - c) Both a) and b)
  - d) Neither a) nor b)
- (viii) In the context of the Z-Transform, what does the region of convergence (ROC) infer

- a) The region in the Z-plane where the Z-Transform converges
- b) The region in the time domain where the signal is nonzero
- c) The region in the frequency domain where the signal has significant energy
- d) The region in the s-plane where the Laplace Transform converges
- (ix) Select the main purpose of an all-pass filter
  - a) To amplify specific frequencies
  - b) To reject noise in signals
  - c) To affect the phase without changing amplitude
  - d) To pass low-frequency components
- (x) Name the type of filter that allows all frequencies to pass through without attenuation
  - a) High-pass filter
  - b) Bandpass filter
  - c) Bandstop filter
  - d) Low-pass filter
- (xi) Choose a filter that is used to eliminate a specific frequency or a narrow range of frequencies from a signal
  - a) High-pass filter
  - b) Notch filter
  - c) Bandpass filter
  - d) Bandstop filter
- (xii) How does a mixed-phase system differentiate itself from minimum and maximum phase systems?
  - a) It has a linear phase response
  - b) It combines both minimum and maximum phase components
  - c) It rejects specific frequencies
  - d) It amplifies all frequencies
- (xiii) Indicate from the following that how does subband coding help in efficient signal compression.
  - a) By eliminating all high-frequency components
  - b) By reducing the signal's amplitude
  - c) By coding the signal into different frequency bands
  - d) By increasing the signal's sampling rate
- (xiv) Suppose you have a signal that you want to divide into frequency subbands for compression. Which technique would be most associate?
  - a) Interpolation
  - b) Polyphase decomposition
  - c) Nyquist filtering
  - d) Decimation
- (xv) Select primary function of the TMS320C6713 processor
  - a) Image processing
  - b) Digital signal processing
  - c) Graphics rendering
  - d) Audio synthesis

### Group-B

(Short Answer Type Questions)

3 x 5=15

2. State sampling theorem and name the different sampling techniques. (3)
3. Evaluate the DFT of the sequence  $x(n) = \{1, 2, 1, 0\}$ . (3)
4. State the time shifting and Time scaling property of Z-Transform. (3)
5. Write properties of Chebyshev filters (Type 1). (3)
6. Let's consider a simple digital filter with the following specifications: (3)  
 Sampling rate ( $F_s$ ): 1000 Hz, Cutoff frequency ( $F_c$ ): 200 Hz, Bandwidth (B): 100 Hz  
 Calculating cutoff frequencies for a bandpass filter.

Explain notch filter.

OR

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(3)

Group-C  
(Long Answer Type Questions)

5 x 6=30

7. Explain properties of frequency selective filter. (5)
8. List the properties of continuous time unit impulse signal. (5)
9. Evaluate whether the following signals are causal or non-causal. (5)

$$y(n) = \sin[x(n)]$$

$$y(n) = x(-n)$$

10. Analyze the concept of a multirate filter and its applications in signal processing. (5)
11. Deduce the relation between Z-Transform and Fourier Transform. (5)
12. Explain the role of DSP in radar signal processing. (5)

OR

Explain the role of DSP in PET (Positron Emission Tomography) scan in medical applications. (5)

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