



TECHNICAL UNIVERSITY OF MOMBASA

SCHOOL OF ELECTRICAL AND ELECTRONIC ENGINEERING

ELECTRICAL AND ELECTRONIC ENGINEERING DEPARTMENT

UNIVERSITY EXAMINATION FOR:

BACHELOR OF TECHNOLOGY ELECTRICAL AND ELECTRONICS ENGINEERING

TEE 4313 DIGITAL SIGNAL PROCESSING

END OF SEMESTER EXAMINATION

SERIES: APRIL 2025

TIME: 2 HOURS

DATE: April 2025

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of **five** Questions; Question ONE is compulsory. In addition attempt any Other TWO Questions.

Do not write on the question paper.

Question ONE (Compulsory)

- (a) (i) Explain the applications of a digital signal processing system in digital sound audio effects.
- (ii) With appropriate equations describe how the following effects are obtained for an audio sequence $x(n)$.

(I) Echo

(II) Flanging and chorusing

(III) Reverberation

(12 marks)

- b (i) State the **FOUR** properties of the twiddle factor.

- (ii) State the expression for Digital convolution.

(8 marks)

- c (i) Determine the convolution of two sequences:

$$x(n)=2, 1, 0, 1, 2 \text{ and } h(n)=1, -2, 1, 1$$

- (ii) Determine the circular convolution of $h(n)=1, 2, -1, 1$ and $x(n)=1.5, 2, 0, 1$

- (iii) Use overlap add method to determine the convolution of $x(n)=[1, 3, 2, -3, 0, 2, -1, 0, -2]$ and $h(n)=[1, 0, 1,]$ (11 marks)

Question TWO

- (a) (i) State the three descriptions of DFT (10 marks)
 (ii) Derive the expression of DFT (10 marks)
- (b) Describe the window method of FIR design (10 marks)

Question THREE

Determine the DFT for the following sequence $x(n)=[0, 1, 2, 3, 0, 1, 2, 3]$.

- (a) Directly (10 marks)
 (b) Using decimation in time and in place Radix two fast Fourier transform (10 marks)

Question FOUR

- (a) A first order system is described by a difference equation:

$$y(n)=x(n)+ky(n-1) \quad |k|<1$$

With $y(-1)=0$

- (i) Determine $h(n)$
 (ii) Plot the magnitude and phase responses (14 marks)

- (b) A second order system is described by the following difference equation:

$$y(n)=-0.2y(n-1)-0.4y(n-2)+3x(n)+2x(n-1)+x(n-2)$$

Realize the filter using:

- (i) Direct form I
 (ii) Direct form II (6 marks)

Question FIVE

- (a) Describe using appropriate equations the application of digital filters in the following operations:

- (i) Noise reduction
 (ii) 1st order IIR smoothing
 (iii) Notch filter
 (iv) Comb filter (12 marks)

- (b) With the aid of a diagram and equations show the necessary conditions for an LTI system to be:

- (i) Stable

(ii)Causal

(8 marks)