



TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ELECTRICAL AND ELECTRONIC ENGINEERING
ELECTRICAL AND ELECTRONICS ENGINEERING DEPARTMENT

UNIVERSITY EXAMINATION FOR:

BSC ELECTRICAL AND ELECTRONICS ENGINEERING

EEE2519 DIGITAL FILTERS

END OF SEMESTER EXAMINATION

SERIES: MAY 2016

TIME: 2 HOURS

DATE:

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

- (a) (i) Illustrate **THREE** main characteristics of LTI systems.
- (ii) Derive the necessary conditions for LTI systems to be:
- (I) Causal
 - (II) Stable

(11 marks)

- (b) (i) State the general expression for digital convolution.
- (ii) Using convolution table determine the output for an input sequence:
 $x(n) = 1, 2, 1, 2, 1$ into an LTI system of $h(n) = 2, 1, -1, 1$
- (iii) Using matrix form to compute the circular convolution of :
 $h(n) = [1, 2, -1, 1]$ with $x(n) = [1.5, 2, 0, 1]$

(11 marks)

- (c) Explain how a digital signal processing system may be used for:
- (i) Digital waveform generation
- (ii) Complex music seconds generation

Question TWO

Design an FIR low pass filter with the following specifications. Cut off frequency 1.5Hz, transition width 0.5kHz stop band attenuation 50dB, sampling frequency $f_s = 8kHz$.

(20 marks)

Question THREE

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 FOUR

(a) With the aid of diagram, equations as appropriate, describe how a digital filter is used to implement:

- (i) Noise reduction
- (ii) First order IIR smoother
- (iii) Notch filter
- (iv) Comb filter

(12 marks)

(b) (i) Use bilinear transform to determine equivalent discrete transfer function for an analog filter is given by:

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

(ii) State **FOUR** characteristics of impulse invariance designed filters.

(8 marks)

Question FIVE

(a) (i) Show that Radix 2 decimation in time and in place EFT may be used to reduce the number of computations for DFT.

(ii) State the **FOUR** properties of twiddle factor.

(10 marks)

(b) Use FFT to compute DFT of $x(n) = [0, 2, 3, 4, 3, 4, 2, 0]$

(10 marks)