TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ELECTRICAL AND ELECTRONIC ENGINEERING

ELECTRICAL AND ELCTRONICS 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 descrete transfer function for an analog filter is given by:

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

.

(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)