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: SEPT 2017

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 (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

(7 marks)

(b) (i) State the expression for DFT and write it in matrix form for a sequence of length n = 4.

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

(8 marks)

(c) (i) State the expression for Digital convolution.

(ii) Determine the convolution of two sequences:

$$x(n) = 1, 2, 1, 2, 1 \quad and \quad h(n) = 2, 1, -1, 1$$

(4 marks)

(d) (i) Determine the circular convolution of $h(n) = [1, 2, -1, 1]$ and $x(n) = [1.5, 2, 0, 1]$

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

(iii) Realize the following IIR filter using:

(I) Direct form 1
(II) Canonical form

$$H(z) = 2 - 3Z^{-1} + 4Z^{-3} / 1 + 0.2Z^{-1} - 0.3Z^{-3} + 0.5Z^{-4}$$

(11 marks)

Question TWO

Use bilinear transformation of Butterworth filter with the following specifications.

$$0.89125 \leq \left| He^{jw} \right| \leq 1 \quad 0 \leq w \leq 0.2\pi$$
$$\left| He^{jw} \right| \leq 0.17783 \quad 0.3\pi \leq w \leq \pi$$

To:

(a) Compute order of filter (9 marks)

(b) Locate poles on S plane (3 marks)

(c) Determine discrete transfer function (4 marks)

(d) Plot magnitude and delay responses (4 marks)

Question THREE

(a)   Show that the decimation in time and in place Radix two fast Fourier transform may be used to compute the DFT of a sequence.   **(10 marks)**

(b)   Use Decimation in time and in place radix two fast fourier transform to compute the DFT of:

$$x(n) = [0, 2, 3, 4, 3, 4, 2, 0]$$

Question FOUR

(a)   Derive the general form of Discrete Fourier transform pair.   **(10 marks)**

(b)   Determine and plot the magnitude and phase response a unit discrete sequence:

$$h(n) = 1, \quad 0 \leq n - 1$$ **(10 marks)**

Question FIVE

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

(i)   Noise reduction
(ii) 1st order 11R 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)