**KENYATTA UNIVERSITY**
**UNIVERSITY EXAMINATIONS 2010/2011**
**FIRST SEMESTER EXAMINATION FOR THE DEGREE OF MASTER OF SCIENCE IN COMPUTER ENGINEERING**

**SCE 504 : DIGITAL SIGNAL PROCESSING**

**DATE: TUESDAY 30TH NOVEMBER 2010** **TIME: 2.00 P.M. - 4.00 P.M.**

**INSTRUCTIONS**

**Answer Questions ONE and any other TWO.**

## QUESTION ONE

1a). Consider the sequence x(n) = $\{a^n, n \geq 0$
$\{-b^n, n \leq -1$ *where* $|a| < |b|$.

Determine the z-transform of the above equation and indicate the region of convergence.

NB: $s = (2z-1)/(Tz+1)$ and $z = (1+T_s/2)/(1-T_s/2)$ (6 Marks).

b). Discuss an ideal discrete-time low pass filter in the frequency response. (8 Marks).

c). Name four properties of the Fourier Transform for Discrete Time signals and give their respective functional forms. (8 Marks).

d). Use the bilinear transformation to determine the characteristic of a digital filter if the corresponding analog filter has transfer function

$H(s) = H_0/(s-s_1)$. (8 Marks).

## QUESTION TWO

2a). Draw the block diagram for digital signal processing for a continuous signal and explain it's the role. (6 Marks).

b). Name the three analog filters commonly used in digital signal processing and explain the parameters each optimizes. (6 Marks).

c). Discuss the impulse response of a digital filter giving its distinction and demonstrate your explanation by using the filters system function. (8 Marks).

## QUESTION THREE

3.a). Write the z-transform of the function $f(t) = Ae^{-at}$, $t \geq 0$ which is sampled every T seconds, i. e. $t = kT$. (8 Marks ).

b). Design a high pass filter that passes frequencies greater than 20 kHz. The sampling frequency is 100 kHz. Use the Fourier design approach and assume that the pass-band gain is unity. (4 Marks ).

c). Discuss the procedures for digital filter design by bilinear transform methods. (8 Marks ).

## QUESTION FOUR

4a). In the study of frequency domain representation of discrete time systems and signals, in the evaluation of frequency response, determine the system function and plot/draw the respective response, magnitude and phase of the frequency response of the system given a system with unit –sample response:

$$h(n) = \begin{cases} 1, & 0 \leq n \geq N-1 \\ 0, & \text{elsewhere.} \end{cases}$$

(5 Marks ).

b). A Butterworth filter must have an attenuation of at least 20dB at 6kHz, twice the cutoff frequency. Deduce the transfer function of the appropriate low-pass filter. (9 Marks ).

c). Given a sequence x (n) and its Fourier transform $X(e^{j\omega})$, write the Parseval's theorem that shows the relationship between them. (6 Marks ).

## QUESTION FIVE

c). Give a comparison of IIR and FIR Digital Filters. (7 Marks ).

b). Name four properties of Discrete Fourier Transform and give the mathematical representation of each. (8 Marks ).

c). Find the inverse z-transform for the following series:

$X(z) = \log(1 + az^{-1}), \ |a| < |z|$. (5 Marks ).