TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ELECTRICAL AND ELECTRONIC ENGINEERING

ELECTRICAL AND ELCTRONICS ENGINEERING DEPARTMENT

UNIVERSITY EXAMINATION FOR:

BSC ELECTRICAL AND ELECTRONICS ENGINEERING

EEE2405 ANALOGUE 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.

uestion ONE

(a) For the **FOUR** categories of analog filters, outline second order:

(i) Generalized transfer function

(ii) Specification

(12 marks)

(b) Explain the effect of the following characteristics on filter performance:

(i) Maximally flat

(ii) Roll-off rate

(iii) Linear phase

(6 marks)

(c) Derive generalized expressions for phase and delay in second order:

(i) Low pass filter
(ii) All pass filter

(6 marks)

(d) Realize the LC admittance with an appropriate ladder circuit:

$$Y(s) = \frac{(S^2+1)(S^2+9)(S^2+25)}{S(S^2+4)(S^2+16)}$$

(6 marks)

Question TWO

(a) Explain with appropriate equations and waveforms how an Inverse Chebyshev filter is derived from a Chebyshev filter. **(6 marks)**

(b) (i) Derive the expression for attenuation of Inverse Chevbyshev filter and plot its frequency response.

(ii) Explain the difference between odd and even frequencies

(8 marks)

(c) Derive the expression for the order of an Inverse Chebyshev filter in terms of its specifications. **(6 marks)**

Question THREE

(a) Design a switched capacitor filter to realize the transfer function:

$$T(s) = \frac{(S+100)(S+400)}{(S+200)^2}$$

(9 marks)

(b) Construct a first order switched capacitor filter to process the difference between two voltages V_1 *and* V_2 . V_1 is to be multiplied by a low-frequency gain of 2dB and V_2 by 0dB. The low pass filter should have the cut-off frequency $f_o = 3.6kHz.$ Take clock frequency to be 128kHz. **(8 marks)**

Question FOUR

(a) A 200mV, 45kHz signal is corrupted by a 2V 12kHz sine wave. Design a high pass filter to remove the 2V sine wave such that its remaining magnitude is no larger than 2% of 200mV.The higher frequency gain should be 0dB and pass-band attenuation $\alpha \max \leq 1dB$.Use Chebyshev response with frequency transformation. **(12 marks)**

(b) A low pass function has poles at $\sum \pm j\Omega = 0.5 \pm j0.866$ with a = b = 1, transform it to high pass filter. **(8 marks)**

Question FIVE

(a) (i) State the advantages of transconductance technology in filter design.

(ii) With the aid of diagrams explain the operation of a transconductance cell. **(10 marks)**

(b) Explain with appropriate diagrams and equation how the following are realized in transconductance technology.

(i) 1^{st} order low pass filter (lossy integrator)

(ii) Summer

(iii) Gyrator

(10 marks)