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

SPECIAL/SUPPLEMENTARY EXAMINATION

SERIES: SEPTEMBER 2018

TIME: 2 HOURS

DATE: Sep 2018

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

(i) Generalized transfer function

(ii) Specification

(12 marks)

(b) (i) State the advantage of trans-conductance filters over discrete RC filters.

(ii) Using an appropriate circuit derive the transfer function of a 1^{st} order section for a trans-conductance filter.

(iii) Draw a circuit diagram for differential realization of the filter in (ii).

(10 marks)

(c) Explain the effect of the following on filter performance:

(i) Maximal flatness
(ii) Roll-off rate
(iii) Linear phase

(6 marks)

(d) With the aid of a diagram compare the following in terms of stop band attenuation and delay:

(i) Chebyshev
(ii) Maximally flat
(iii) Inverse Chebyshev
(iv) Elliptic filter

(8 marks)

Question TWO

Design a circuit to implement an elliptic (Cauer) filter with the following specifications $\alpha_{\max} = 0.45dB$, $\alpha_{\min} = 17dB$, cut-off frequency = 2.4kHz which is sharp so that $w_s / w_p = 1.1$. **(20 marks)**

Question THREE

(a) A 200mV, 45 kHz signal is corrupted by a 2V, 12kHz sine wave. Design a high pass filter to remove the 2 V sine wave such that the remaining magnitude is no larger than 20% of 200mV. The high frequency gain should be 0dB and passband attenuation $\alpha_{\max} \le 1dB$. Use low pass to high pass frequency transformation. **(14 marks)**

(b) Design a 1st order switched capacitor filter to process the difference of two voltages V_1 *and* V_2 is multiplied by low frequency gain of 2dB and V_2 by 0dB. The low pass filter should have a cut-off frequency $f_o = 3.5kHz$. Assume that the clock frequency of $f_c = 128kHz$ is large enough so that simple design based on active RC prototype is adequate. **(6 marks)**

Question FOUR

(a) Explain **THREE** reasons why LC ladder circuits are still in application. **(3 marks)**

(b) Realize the LC admittance:

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

Using:

(i) Single component LC ladder.
(ii) Capacitor at input and inductor at termination both shunt and two middle cascade stages of LC parallel circuit.

(17 marks)

Question FIVE

(a) Derive the expression for Inverse Chebyshev filter from the Chebyshev transfer function. **(6 marks)**

(b) Determine the transfer function for inverse Chebyshev filter with the following design specifications.

$\alpha_{\min} = 18dB$ $\alpha_{\max} = 0.25dB$
$ws = 140\ krad/s$ $w_p = 100krad/s$

(14 marks)