MACHAKOS UNIVERSITY

University Examinations for 2018/2019

SCHOOL OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

THIRD YEAR SPECIAL/SUPPLEMENTARY EXAMINATION FOR

BACHELOR OF SCIENCE (ELECTRICAL AND ELECTRONICS ENGINEERING)

EEE 307: NETWORK ANALYSIS & SYNTHESIS

DATE: **TIME**:

INSTRUCTIONS TO STUDENTS

1. *This paper contains 5 questions.*
2. *Attempt* ***Question One*** *and* ***Any Other Two questions***
3. *Show calculations where applicable*

QUESTION ONE (30 MARKS)

a) Design a low pass filter with Chebyshev Type I response satisfying the following specifications: $\alpha_{\max} = 0.25\ dB$, $\alpha_{\min} = 18\ dB$, $\omega_p = 1000\ rad/s$ and $\omega_s = 1400\ rad/s$. [10 marks]

b) Synthesize the following function using basic synthesis procedures

$$Z(s) = \frac{6s^3 + 3s^2 + 3s + 1}{6s^3 + 3s}.$$ [9 marks]

c) For a given function to satisfy analogue filter design theorem, it must satisfy five constraints. State these constraints. [5 marks]

d) Determine if the following function satisfies the analogue filter theorem design and plot the poles and zeros of the function on an s-plane. [6 marks]

$$Z(s) = \frac{1}{s^4 + 2s^2 + 5s}$$

QUESTION TWO (20 MARKS)

a) Test whether the following function is a positive real function or not

[5 marks]

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

b) Determine the order of the inverse Chebyshev response that realizes the following specifications:

(i) The passband extends from $\omega = 0$ to $\omega = 250\, rad/s$.

(ii) For frequencies $\omega \geq 2000\ rad/s$, the response must be attenuated by at least $60\, dB$.

(iii) The passband attenuation should not exceed $0.1\, dB$. [2 marks]

c) Using the order obtained in (b), determine the poles and zeros of the filter and hence $H(s)$. [11 marks]

d) Sketch the Chebyshev type I attenuation response for $n = 7$ [2 marks]

QUESTION THREE (20 MARKS)

a) Synthesize the following function using the 1st Cauer canonical form.

$$Z(s) = \frac{s(s^2+3)(s^2+5)}{(s^2+2)(s^2+4)}$$ [10 marks]

b) Physically realizable passive driving-point immittance must be positive real functions. State the properties of positive real functions. [3½ marks]

c) Test whether the function $F(s) = \dfrac{3s^2+8}{s(s^2+4)}$ is positive real. [6½ marks]

QUESTION FOUR (20 MARKS

a) State the properties of an RC networks. [5 marks]

b) Synthesize the admittance of following LC impedance function. [7 marks]

$$Z(s) = \frac{6s^4+42s^2+48}{s^5+18s^3+48s}$$

c) Find the transfer impedance $V_1(s)/I_1(s)$ and the voltage ratio $V_2(s)/V_1(s)$ for the circuit shown in Fig. 4 c). [8 marks]

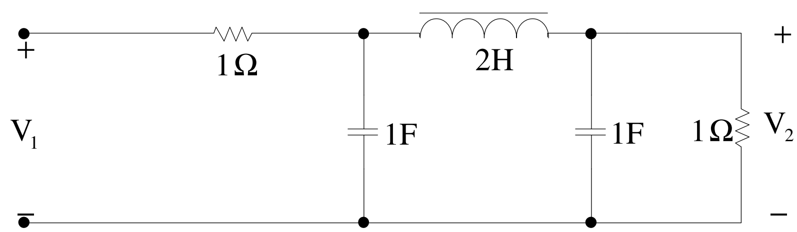

Fig. 4 c)

QUESTION FIVE (20 MARKS)

a) Define the following terms as used in analogue filters:
   (i) Electrical filter
   (ii) Transitional band
   (iii) Time invariant function
   (iv) Positive real function [4 marks]

b) Synthesize the admittance function as using the method of removal of a constant. [7 marks]

$$Y(s) = \frac{5s+3}{2s+4}$$

c) An impedance function has the pole zero pattern shown in Fig. Q5 c). If $Z(-2) = -\frac{130}{16}$, Synthesize the impedance in Cauer form I. [9 marks]

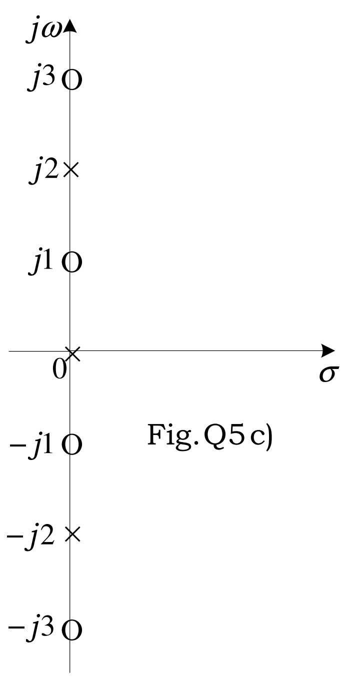

Fig. Q5 c)