



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: $\alpha_{\max} = 0.25 \text{ dB}$, $\alpha_{\min} = 18 \text{ dB}$, $\omega_p = 1000 \text{ rad/s}$ and $\omega_s = 1400 \text{ rad/s}$. [10 marks]
- b) Synthesize the following function using basic synthesis procedures

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

- 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 $\omega = 250 \text{ rad/s}$.
 - (ii) For frequencies $\omega \geq 2000 \text{ rad/s}$, 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.

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

- 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 $F(s) = \frac{3s^2 + 8}{s(s^2 + 4)}$ 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]

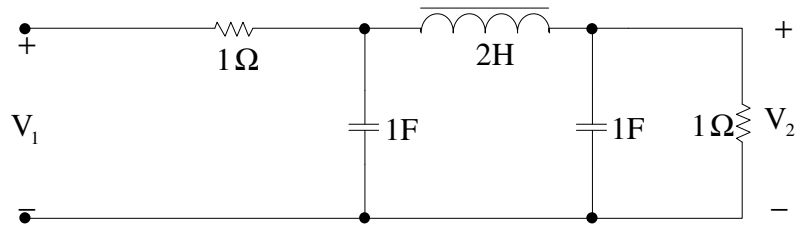


Fig. 4 c)

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

$$Z(-2) = -\frac{130}{16}, \text{ Synthesize the impedance in Cauer form I. } [9 \text{ marks}]$$

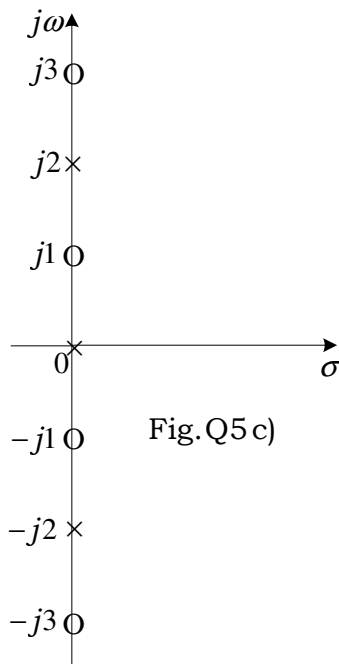


Fig. Q5 c)