



# MACHAKOS UNIVERSITY

University Examination 2018/2019

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

THIRD YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (ELECTRICAL AND ELECTRONICS ENGINEERING)

EEE 307: NETWORK ANALYSIS & SYNTHESIS

DATE: 22/5/2019

TIME: 8.30-10.30 AM

## INSTRUCTIONS

*Answer Question ONE and any other TWO Questions.*

*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 driving point admittance of the function given below using 2<sup>nd</sup> order Foster form and draw the realized circuit. (9 marks)
- $$Z(s) = \frac{4(s+2)(s+5)}{(s+1)(s+4)}$$
- 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) Passive filters are no longer being used in design of circuits but instead active filters are used due their limitations. State these limitations (4 marks)
- b) For the circuit shown in Fig. Q2 b), calculate the Y-parameters. (8 marks)

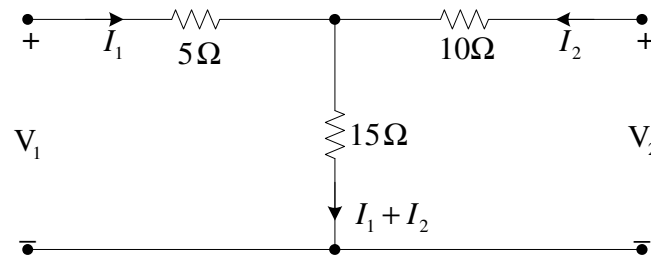


Fig. Q2 b)

- c) Give the following specifications of a low pass filter:  $\alpha_{\max} = 0.55 \text{ dB}$ ,  $\alpha_{\min} = 22 \text{ dB}$ ,  $\omega_p = 1000 \text{ rad/s}$ ,  $\omega_s = 3500 \text{ rad/s}$ . Design the filter with a Butterworth response and show the poles on an s-plane. (8 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 LC 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)

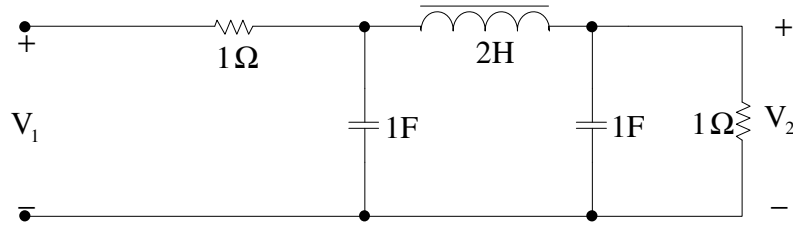


Fig. 4 c)

### QUESTION FIVE (20 MARKS)

- a) Design an inverse Chebyshev low pass filter to satisfy the following specifications:

$$\alpha_{\max} = 0.3 \text{ dB}, \alpha_{\min} = 22 \text{ dB}, f_s = 30 \text{ kHz} \text{ and } f_s = 10 \text{ kHz} \quad (11 \text{ marks})$$

- b) The denominator of a polynomial of the system function that satisfies analog filter theorem belongs to a class of polynomials called Hurwitz polynomials. Explain the four conditions necessary for a polynomial to be Hurwitz. (6 marks)

- c) Test whether the polynomial  $F(s)$  is a Hurwitz polynomial.

$$F(s) = s^4 + s^3 + 5s^2 + 3s + 4 \quad (3 \text{ marks})$$