MACHAKOS UNIVERSITY

University Examinations for 2021/2022

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

THIRD YEAR SECOND SEMESTER 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) Determine the Z-parameters of the network shown in Fig. Q1 a). (8 marks)

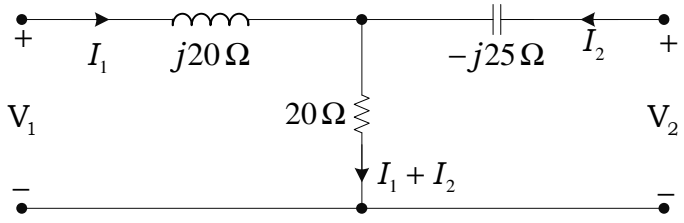

Fig. Q1 a)

b) Given that the desired specifications of a Chebyshev Type I lowpass filter are as follows: $\alpha_{\max} = 0.85\,dB$, $\alpha_{\min} = 35\,dB$, $\omega_p = 3{,}500$ rad/s, and $\omega_s = 7{,}500$ rad/s, design the filter the meet the specifications given. (9 marks)

c) Sketch the Chebyshev type I attenuation response for $n = 6$ (2 marks)

d) Test whether the polynomial F(s) is a Hurwitz polynomial.

$$F(s) = s^4 + s^3 + 5s^2 + 3s + 4$$ (5 marks)

e) Synthesize the following impedance function using basic synthesis procedures:

$$Z(s) = \frac{s^2 + 6s + 60}{s(s+10)}$$ (6 marks)

QUESTION TWO (20 MARKS)

a) Given the following specifications of a low pass filter: $\alpha_{max} = 0.4$, $\alpha_{min} = 12\ dB$, $\omega_p = 1000\ rad/s$, $\omega_s = 2200\ rad/s$. Design the filter with a Butterworth response that satisfy the above specifications and show the poles on an s-plane. (7 marks)

b) Test whether the following functions satisfy analog filter design theorem. (6 marks)

$$Z(\omega) = \frac{\omega^2 + 7\omega + 10}{\omega^2 + 5\omega + 4}$$

c) For the circuit shown in Fig. Q2 c), Use ladder network method to find
(i) the transfer impedance $V_1(s)/I_1(s)$
(ii) the voltage ratio $V_2(s)/V_1(s)$ (7 marks)

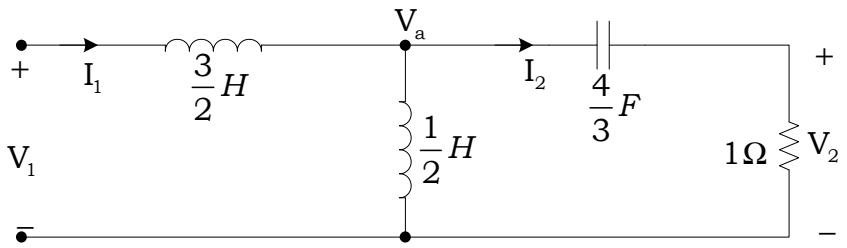

Fig. Q2 c)

QUESTION THREE (20 MARKS)

a) Briefly explain the following terms as used in network synthesis:

(i) Causality
(ii) Hurwitz polynomials
(iii)Positive real functions (3 marks)

b) Test whether the following function is a positive real function: $F(s) = \frac{s+3}{s(s+1)(s+2)}$

(5 marks)

c) Synthesis the following LC network in Foster form I: $Z(s)=\dfrac{s\left(s^2+9\right)\left(s^2+25\right)}{\left(s^2+4\right)\left(s^2+16\right)}$

(8 marks)

d) State the Four properties of an RC network. (4 marks)

QUESTION FOUR (20 MARKS)

a) Find the h-parameters for the circuit shown in Fig. Q4 a). (10 marks)

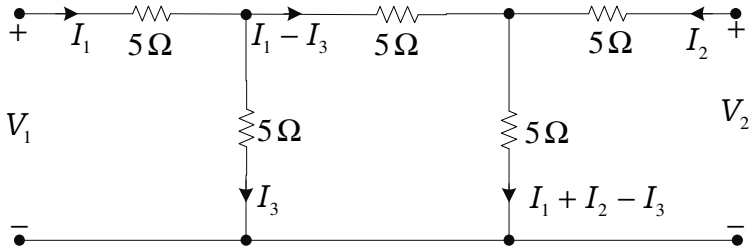

Fig. Q4 a)

b) Synthesize the RC impedance function using Cauer form II:

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

c) State the **Five** properties of an LC networks. (5 marks)

QUESTION FIVE (20 MARKS)

a) Design an inverse Chebyshev low pass filter to satisfy the following specifications: $\alpha_{max}=0.3\,dB$, $\alpha_{min}=22\ dB$, $\omega_s=3000\,\text{rad/s}$ and $\omega_s=1000\ \text{rad/s}$

(11 marks)

b) Synthesize the following RL function using first Cauer form:

$$Z(s)=\frac{s(s+4)(s+6)}{(s+2)(s+5)}$$ (9 marks)