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: $\alpha_{\max} = 0.25\ dB$, $\alpha_{\min} = 18\ dB$, $\omega_p = 1000\ rad/s$ and $\omega_s = 1400\ rad/s$. (10 marks)

b) Synthesize the driving point admittance of the function given below using 2nd 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)

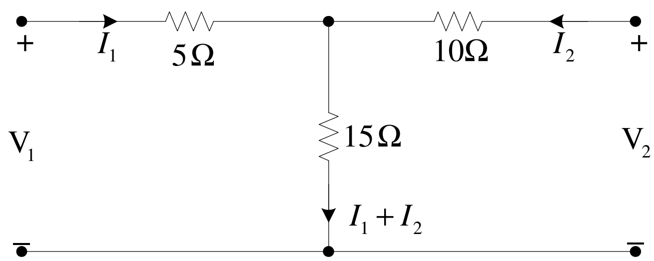

Fig. Q 2 b)

c) Give the following specifications of a low pass filter: $\alpha_{\max} = 0.55\, dB$, $\alpha_{\min} = 22\, dB$, $\omega_p = 1000\, rad/s$, $\omega_s = 3500\, rad/s$. 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.

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

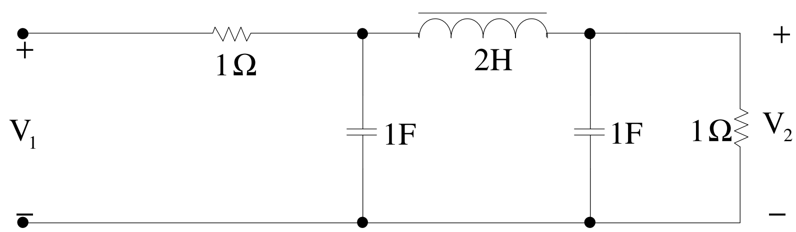

Fig. 4 c)

QUESTION FIVE (20 MARKS)

a) Design an inverse Chebyshev low pass filter to satisfy the following specifications: $\alpha_{\max} = 0.3\,dB$, $\alpha_{\min} = 22\ dB$, $f_s = 30\,kHz$ and $f_s = 10\,kHz$ (11 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 $\mathrm{F(s)}$ is a Hurwitz polynomial.

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