(*University of Choice*)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

UNIVERSITY EXAMINATIONS 2021/2022 ACADEMIC YEAR

THIRD YEAR SECOND SEMESTER EXAMINATIONS

FOR THE DEGREE OF BACHELOR OF SCIENCE IN ELECTRICAL AND COMMUNICATION ENGINEERING

COURSE CODE: ECE 323

COURSE TITLE: NETWORK ANALYSIS AND SYNTHESIS

DATE: WEDNESDAY, APRIL, 27TH, 2022. **TIME:** 3:00 – 5:00 PM

INSTRUCTIONS TO CANDIDATES

Answer Question ONE (1) and ANY OTHER TWO (2) Questions
Scientific calculators may be used

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 6 Printed Pages. Please Turn Over.

QUESTION ONE **[30Marks]**

(a) A DC voltage of 20 V is applied in an *R–L* circuit where $R = 5\Omega$ and $L = 10$ H. Determine;

(i) the current *i*; [3marks]

(ii) voltage across resistor and voltage across the inductor; [3marks]

(iii) the maximum value of stored energy [3marks]

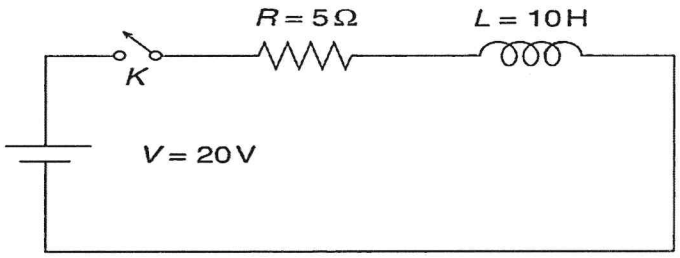


Figure Q1(a)

(b) Determine the time domain current response $i(t)$ of the circuit shown in Figure Q1(b) using Laplace transforms. [5marks]

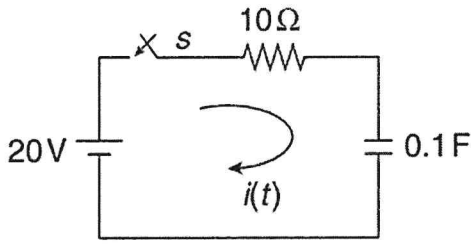


Figure Q1(b)

(c) Given a two-port network in figure Q1(c), determine its Z-parameters. [6marks]

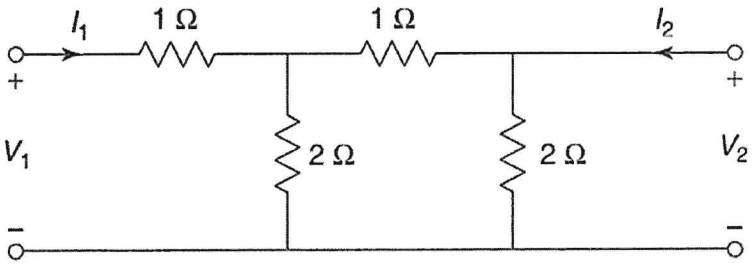


Figure Q1(c)

(d) Test whether the polynomial $P(s) = s^3 + 4s^2 + 5s + 2$ is Hurwitz [4marks]

(e) Draw the pole-zero plot of the following functions

(i) $F(s) = \frac{s(s+2)}{(s+1)(s+3)}$ [3marks]

(ii) $V(s) = \frac{2s^2+80s+1000}{s(s+10)(s+30)}$ [3marks]

QUESTION TWO **[20marks]**

(a) Determine the Z-parameters of the network given in Figure Q2(a)[6marks]

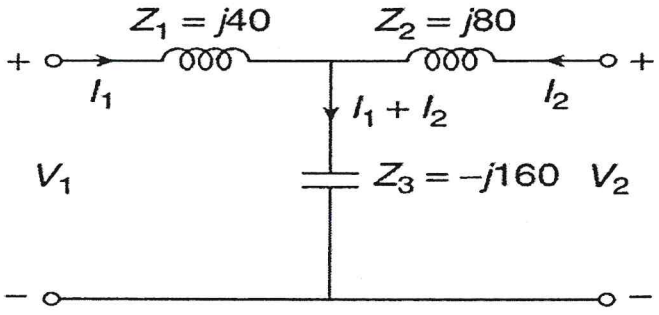
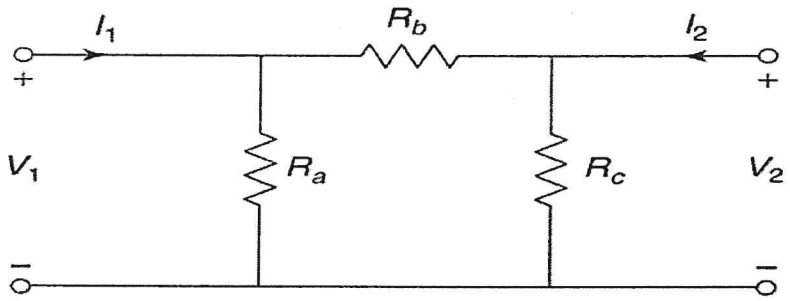


Figure Q2(a)

(b) (i) The admittance parameters of a pi network are Y_{11} = 0.09 mho, Y_{12} = Y_{21} = 0.05 mho and Y_{22} = 0.07 mho. Determine the values of R_a, R_b and R_c.

[4marks]



(ii) Synthesize the impedance function $Z(s) = \frac{s^3+4s}{s^2+2}$ [4marks]

(iii) Realize the Cauer forms of the impedance function [6marks]

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

QUESTION THREE **[20marks]**

(a) (i) Determine the poles and zeros of the impedance of the network shown in shown in Figure Q3(a) and plot them on the s-plane [4marks]

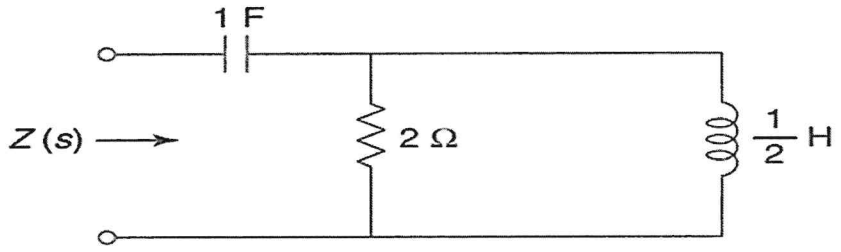
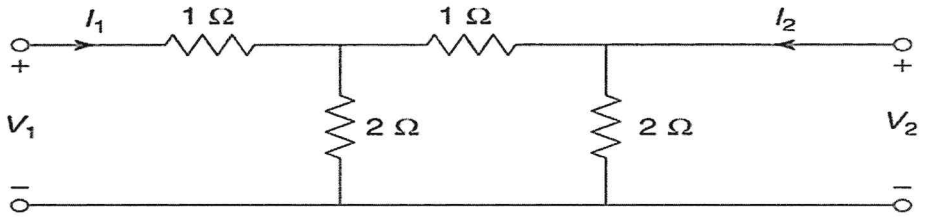


Figure Q3(a)

(ii)Determine transmission (ABCD) parameters for the network

[4marks]



(b) Determine the Y-parameters for the network shown in Figure Q3(b)

[4marks]

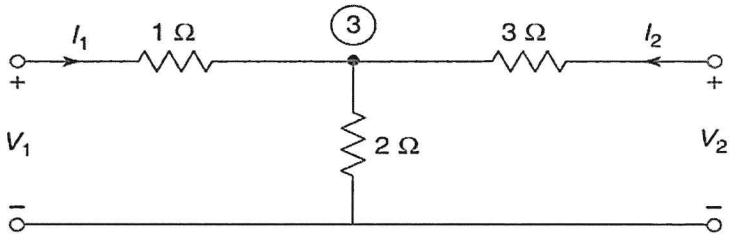
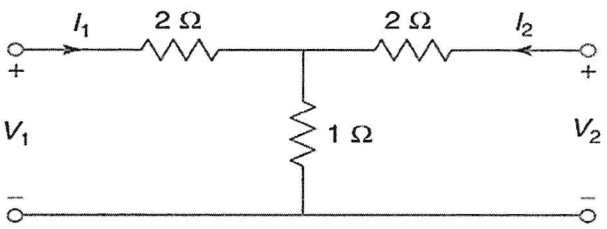


Figure Q3(b)

(c) Two identical sections of the network shown in Figure Q3 (c) are connected in series. Obtain Z-parameters of the overall connection. Determine the transmission parameters of the overall connection.

[4marks]



(ii) $V(s) = \frac{2s^2+80s+1000}{s(s+10)(s+30)}$ [3marks]

QUESTION TWO **[20marks]**

(a) Determine the Z-parameters of the network given in Figure Q2(a)[6marks]

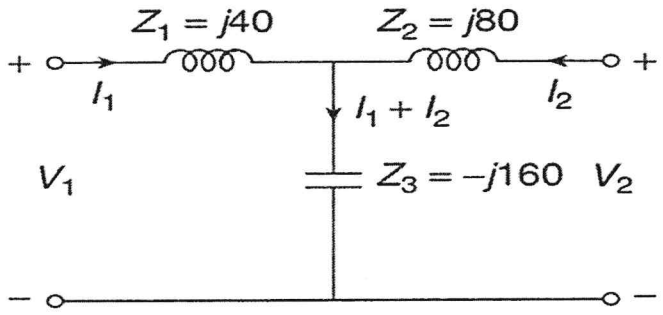
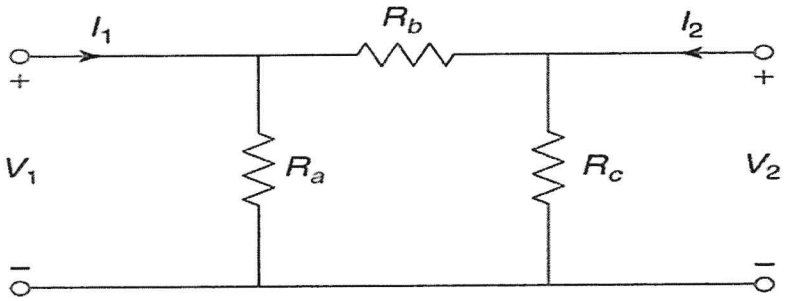


Figure Q2(a)

(b) (i) The admittance parameters of a pi network are Y_{11} = 0.09 mho, Y_{12} = Y_{21} = 0.05 mho and Y_{22} = 0.07 mho. Determine the values of R_a, R_b and R_c.

[4marks]



(ii) Synthesize the impedance function $Z(s) = \frac{s^3+4s}{s^2+2}$ [4marks]

(iii) Realize the Cauer forms of the impedance function [6marks]

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

QUESTION THREE **[20marks]**

(a) (i) Determine the poles and zeros of the impedance of the network shown in shown in Figure Q3(a) and plot them on the s-plane [4marks]

Figure Q3 (c)

(d) The Z-parameters of a two port network are; $Z_{11}=10\Omega$, $Z_{12}=Z_{21}=5\Omega$, $Z_{22}=20\Omega$. Determine the equivalent T-network. [4marks]

QUESTION FOUR [20marks]

(a) A circuit has resistance of 1000Ω and a series capacitance of 0.1 μF. At t=0, it is connected to a 12 V battery as shown in Figure Q4(a). Determine;

i. The current at t = 0 [2marks]
ii. Rate of change of current at t = 0 [2marks]
iii. Rate of change of capacitor voltage at t = 0 [2marks]
iv. Current at t = 0.1 ms [2marks]
v. Voltage across capacitor at 0.1 ms [2marks]

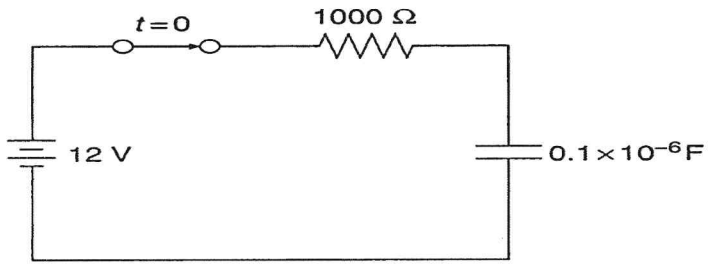


Figure Q4(a)

(b) Determine the current flowing in the circuit of Figure Q4(b) using the following methods.

(i) Differential equation [4marks]
(ii) Laplace transform [4marks]

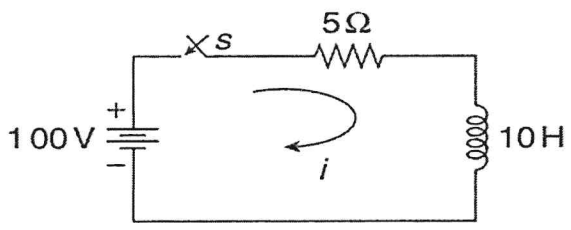


Figure Q4(b)

(c) Realize the Foster Forms of the impedance function [8marks]

$$Z(s) = \frac{(s+1)(s+3)}{s(s+2)}$$

QUESTION FIVE **[20marks]**

(a) Determine hybrid parameters for the network of Figure Q5(a) [8marks]

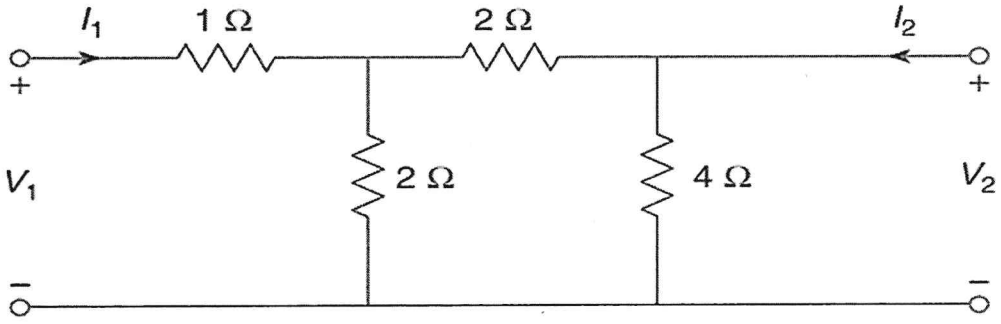


Figure Q5(a)

(b) Realize networks having the following functions

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

(ii) $Z(s) = \frac{6s^3+5s^2+6s+4}{2s^3+2s}$ [4marks]

(iii) $Y(s) = \frac{4s^2+6s}{s+1}$ [4marks]

Appendix

Table 1: Expression of Two-Port Parameters

Name	Express	In terms of	Defining equations
Impedance	V_1, V_2	I_1, I_2	$V_1 = z_{11}I_1 + z_{12}I_2$ and $V_2 = z_{21}I_1 + z_{22}I_2$
Admittance	I_1, I_2	V_1, V_2	$I_1 = y_{11}V_1 + y_{12}V_2$ and $I_2 = y_{21}V_1 + y_{22}V_2$
Hybrid	V_1, I_2	I_1, V_2	$V_1 = h_{11}I_1 + h_{12}V_2$ and $I_2 = h_{21}I_1 + h_{22}V_2$
Transmission	V_1, I_1	$V_2, -I_2$	$V_1 = AV_2 - BI_2$ and $I_1 = CV_2 - DI_2$