The Open University of Sri Lanka
Faculty of Engineering Technology
Department of Electrical and Computer Engineering

Study Programme	: Bachelor of Technology Honours (Engineering)
Name of the Examination	: Final Examination
Course Code and Title	**:EEX3531/ECX3231 Electrical circuits and measurements**
Academic Year	: 2019/20
Date	: 30th July 2020
Time	: 13.30-16.30hrs

General Instructions

1. Read all instructions carefully before answering the questions.
2. This question paper consists of **Eight (8)** questions in **four (4)** pages.
3. Answer any **Five (5)** questions only. All questions carry equal marks.
4. Answer for each question should commence from a new page.
5. No charts/ codes are required.
6. This is a Closed Book Test (CBT).
7. Answers should be in clear hand writing.
8. Do not use Red colour pen.

1. Consider the circuit given in figure 01. The switch S_1 is closed at t = 0 s (before closing the switch the circuit was at neutral state)

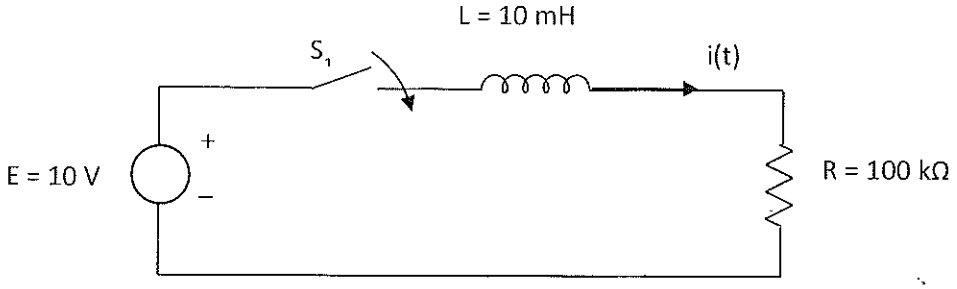

Figure 01

i. Write the differential equation to find the current through the circuit after closing the switch. *(2 marks)*

ii. Convert the differential equation written in (i) in to s – domain using Laplace transform and obtain an expression for the impedance function Z(s) which is also in s – domain. *(4 marks)*

iii. Find the solution for current through the circuit in s – domain (I(s)). *(5 marks)*

iv. Using inverse Laplace transform, derive the expression for current through the circuit in time domain i(t). *(5 marks)*

v. Using the expression derived in step (iii) above, obtain the natural response of the circuit in time domain. *(4 marks)*

2. Consider the two port network and its associated components shown in figure 02.

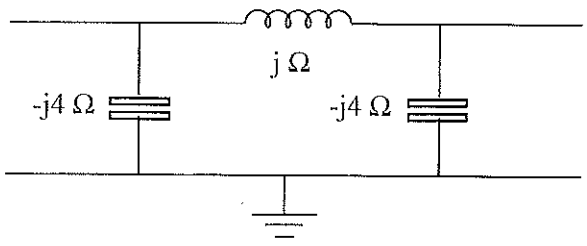

Figure 02

i. Find the ABCD (transmission) parameters of the two port network. *(10 marks)*

ii. Using the parameters found in (i), write the terminal characteristic equation in matrix form. *(02 marks)*

iii. Derive an expression to the characteristic impedance of the given two port network and calculate the value of it. State the assumptions you made. *(04 marks)*

iv. A load impedance of which equals to the characteristic impedance, is connected to a one of the ports. If the voltage at the load (Vrms) is to be maintained at 120 V, what should be the voltage at the other port of the network? *(04 marks)*

3. Write short notes for each topic given below. The short note may include application examples, method of measurement and sketches where applicable. Each short note should not exceed 150 words. *(5 X 4 = 20 marks)*

i. Current transformer and potential transformer as measuring instruments.
ii. Guard terminal used in high resistance measurements.
iii. Use of oscilloscope to observe the B – H loop of a magnetic specimen.
iv. Use of cathode ray (analogue) oscilloscope to observe the transient response of an electrical circuit.

4. Consider the RL circuit shown in figure 03.

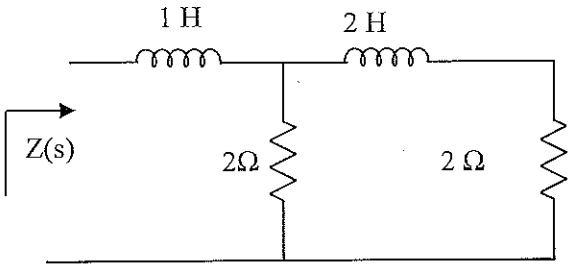

Figure 03

i. Derive the driving point impedance function Z(s) for the given circuit. *(4 marks)*
ii. Draw the pole-zero diagram for the given circuit. *(4 marks)*
iii. Redesign the circuit using Foster 1st form and Cauer 2nd form of network synthesis. (Clearly indicate the steps of calculation for each type of synthesis) *(12 marks)*

5. Answer the questions in both part 'a' and part 'b' below.
i. Define the term 'RMS' of a voltage signal. *(2marks)*
ii. Calculate RMS value of the wave form shown in figure 04. *(2marks)*

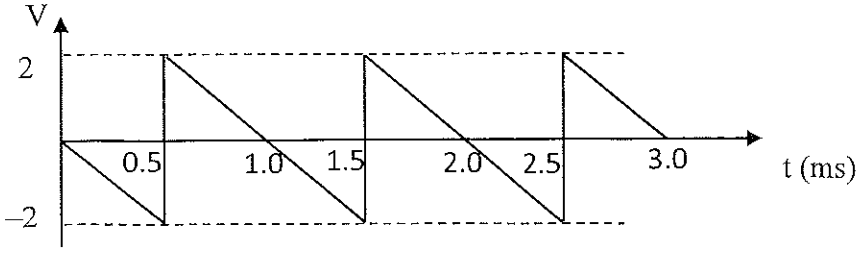

Figure 04

iii. The waveform of the voltage signal (shown in figure 04) is measured using following types of voltmeters separately.

a) Average responding voltmeter

b) True RMS voltmeter

Calculate the reading of each voltmeter. *(12 marks)*

iv. Calculate the percentage error of each reading in (iii), when compared to the true RMS value of the waveform. *(4 marks)*

6. Consider the circuit given in figure 05.

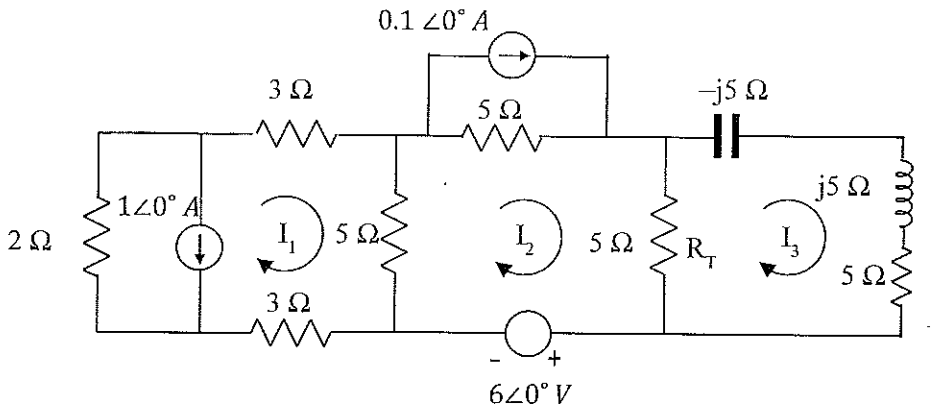

Figure 05

i. Redraw the circuit after converting all current sources to equivalent voltage sources. *(4 marks)*

ii. Apply mesh analysis and directly obtain the matrix equation. *(8 marks)*

iii. Solving matrix equation in (ii), determine mesh currents I_1,I_2 and I_3 *(5 marks)*

iv. Find the current through resistor R_T. *(3 marks)*

v.

7. Answer the following questions.

i. List down two real world examples where the measurement of insulation is important and write what are the benefits of measuring insulation for each example. *(4 marks)*

ii. A PVC insulated single core cable has been given to test its insulation. The wire is 100 m long and you are required to measure the insulation of the full length of the wire.

a) Draw a sketch of the experimental setup to measure the insulation of the wire. (Physical view). *(5 marks)*

b) Draw the simplified circuit diagram of the experimental setup. *(4 marks)*

c) List down two assumptions made during the experiment. *(4 marks)*
d) Write the equation to calculate the insulation. (Use standard notation) *(3 marks)*

8.

i. Briefly describe a method used to measure magnetic flux density. *(05 marks)*
ii. Briefly explain how "dielectric loss" affects the operation of an electrical circuit. *(05 marks)*
iii. Explain the method of measuring capacitance and loss factor of an insulating material using Schering Bridge.

For each of the answers may include,

a) circuit diagram,
b) balance equations,
c) assumptions made. *(10 marks)*