THE OPEN UNIVERSITY OF SRI LANKA
Faculty of Engineering Technology
Department of Electrical & Computer Engineering

Bachelor of Technology Honours in Engineering

Final Examination (2016/2017)
ECX3231: Electrical circuits and measurements

Date: 17th November 2017 (Friday) **Time: 1:30 pm – 4:30 pm**

This question paper consists of eight questions. Answer **any five** questions. All questions carry equal marks.

Q1. Consider the circuit given in figure 01. The switch S1 is closed at t = 0s (Before closing the switch the circuit is at neutral state)

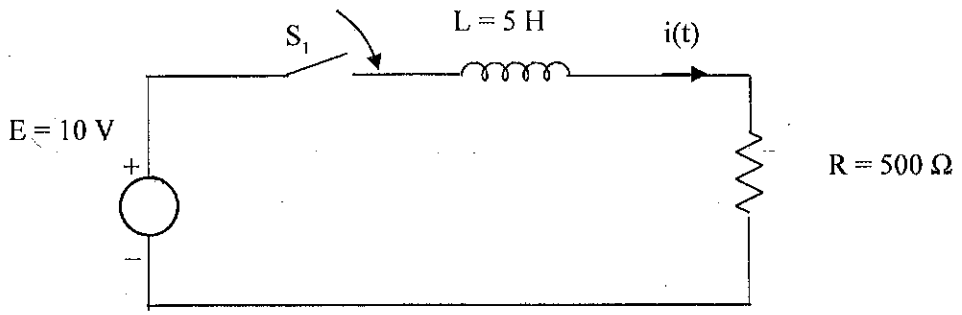

Figure 01

(i). Write the differential equation to find the current through the circuit after closing the switch. *(02 marks)*

(ii). Convert the differential equation obtained in (i) in to s – domain using Laplace Transform *(03 marks)*

(iii). Obtain an expression for the impedance function Z(s) in s – domain. *(02 marks)*

(iv). Find the solution for current through the circuit in s – domain I(s). *(04 marks)*

(v). Derive an expression for the current through the circuit i(t) in time domain using inverse Laplace transform. *(05 marks)*

(vi). Obtain the natural response of the circuit in time domain using the expression derived in step (iv) above. *(04 marks)*

Q2. Consider the RLC circuit shown in figure 02. At t = 0 the switch S1 is closed. (Before closing the switch the circuit is at neutral state)

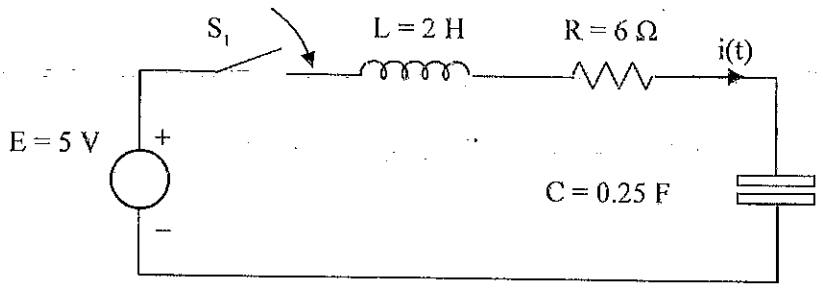

Figure 02

(i). Write a differential equation relating voltages across each element using Kirchhoff's voltage law. *(04 marks)*

(ii). Solve the differential equation obtained in (i) and derive an expression for the current through the circuit for t > 0. *(14 marks)*

(iii). State the type of the response of this circuit. *(02 marks)*

Q3.

(a)

(i). Briefly explain how the internal impedance of a voltmeter can change the readings from the actual values. You may use appropriate circuit diagram. *(03 marks)*

(ii). Define the term RMS (route mean square) in waveform measurements. *(03 marks)*

(b) Figure 03 shows a waveform pattern of a voltage signal

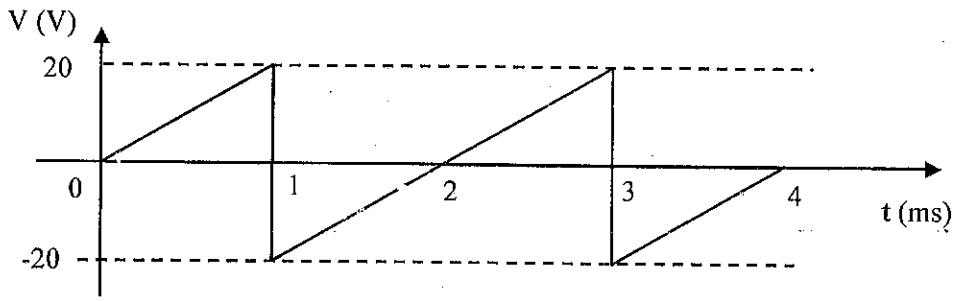

Figure 03

(i). Calculate the RMS value of the voltage waveform shown in figure 03. *(08 marks)*

(ii). What would be the reading if the waveform shown in figure 03 was measured using an average responding voltmeter? *(06 marks)*

Q4. Consider the RC circuit shown in figure 04.

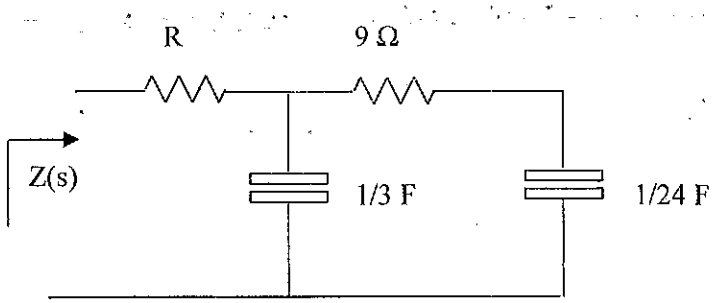

Figure 04

(i). Derive the driving point impedance function Z(s) for the given circuit. *(02 marks)*
(ii). Calculate the value of R, if the system is required to have zeros at s = – 2 and s = – 4. *(04 marks)*
(iii). Draw the pole-zero diagram for the given circuit. *(02 marks)*
(iv). Redesign the circuit using foster 2nd form and Cauer 2nd form. *(12 marks)*

Q5. Consider the two port network and its associated components shown in figure 05.

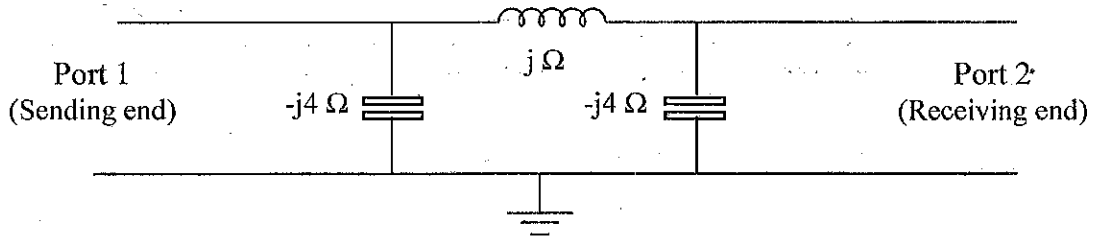

Figure 05

(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 find the value of it. State the assumptions you made. *(04 marks)*
(iv). Consider an AC generator is connected to port 1(sending end) and a load is connected to port 2 (receiving end). If the voltage at the load is to be maintained at 100 V_{RMS}, determine the magnitude and phase angle of sending end voltage (which is at port 1). Note that, the load impedance is equal to the characteristic impedance of the two port network. *(04 marks)*

Q6.

(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.

You may include,

a) Circuit diagram
b) Balance equations
c) Assumptions made

(10 marks)

Q7. Consider the circuit given in figure 06.

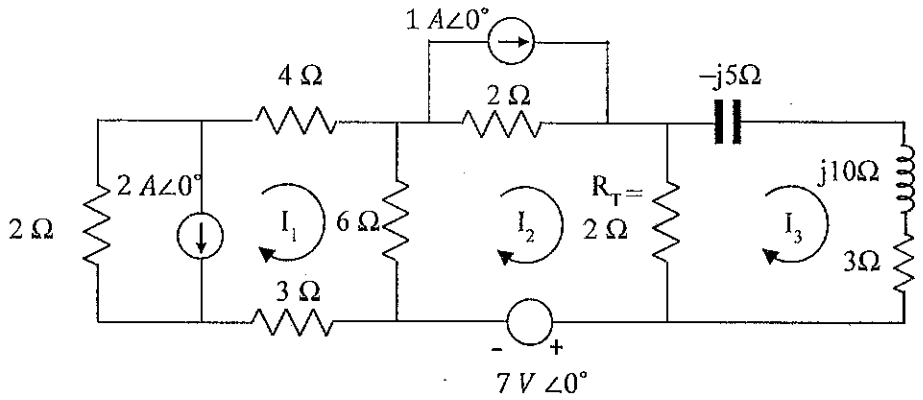

Figure 06

(i). Redraw the circuit after converting all current sources to equivalent voltage sources. *(04 marks)*

(ii). Apply mesh analysis and directly obtain the matrix equation. *(08 marks)*

(iii). Solving matrix equations, find mesh currents I_1,I_2 and I_3 *(06 marks)*

(iv). Find the current through resistor R_T. *(02 marks)*

Q8. Write short notes for each topic given below. You may limit each short note to a maximum of 150 words. Use illustrations wherever necessary. Each topic will carry equal marks. *(4 × 5 = 20 marks)*

(i). Selection of variable components of an AC bridge circuit to obtain the balance condition effectively.

(ii). The significance of Potential transformer and Current transformer in electrical measurements.

(iii). Use of X-Y mode of the oscilloscope to plot the V-I characteristics of a rectifier diode. (You are required to draw a sketch of the connection diagram)

(iv). Guard terminal used in high resistance measurements.

(4 X 5 = 20 marks)