The Open University of Sri Lanka
Department of Electrical and Computer Engineering
Bachelor of Technology - Level 05

ECX5231 – Network Theory
Final Examination 2009/2010

Duration: 3 hours

Date: 20.03.2010   Time: 13.30-16.30

This paper contains eight questions over three pages. All questions carry equal marks. Answer any five questions.

Q1. A simple linear electrical circuit is shown in the figure Q1. Analyze the sinusoidal steady state behaviour of the circuit with help of simulation steps given below.
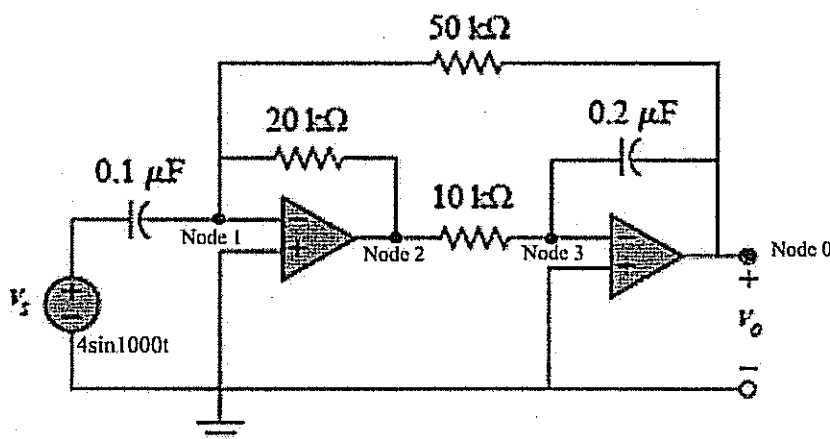

Figure Q1

(a) Write stamps for each element of the circuit.

(b) Formulate given circuit with help of the stamps.

(c) Use an appropriate equation solving algorithm to find the sinusoidal steady state voltages of the circuit using the formulation.

Q2. Circuit simulation problem comprises of modelling and simulation of electrical circuits. Hence, for efficient circuit simulation, simulation process must be optimized and efficient models must be used.

(a) Briefly describe how memory utilization can be enhanced with an extra burden on the processor in the sparcity programming

(b) Briefly explain the relationships between accuracy of the results, model complexity, and resources requirement with an illustrative circuit component having range of models.

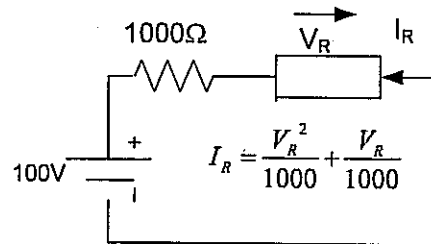Q3. A simple circuit having a non linear resistor is shown in the figure Q3.

$$I_R = \frac{V_R^2}{1000} + \frac{V_R}{1000}$$

Figure Q3

(a) Represent the given circuit with the help of companion network model of the non linear circuit element

(b) Find the DC steady state current through the circuit by performing three iterations.(Take initial guess for the voltage across non linear element as zero volts)

(c) Briefly explain why it is required to have an efficient algorithm to simulate non linear circuit components.

Q4. Use companion network models to find transient output of the circuit shown in the figure Q4 when a unit amplitude step is applied at the input.
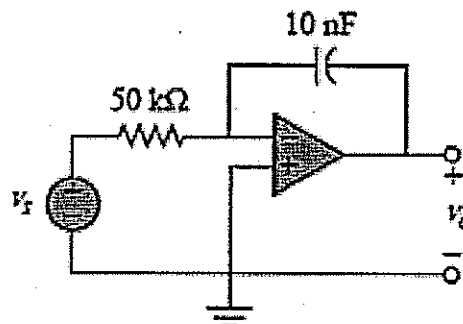

Figure Q4

(a) Redraw the circuit by replacing capacitor from its companion network model

(b) Obtain a formulation for the circuit

(c) Determine output voltage at 0.1mS and 0.2 mS after applying the input (Assume initial voltage across the capacitor as zero).

Q5. Briefly explain the role of three of following utilities used in circuit simulation

(a) Schematic capturing

(b) Rich device library

(c) Use of macro models

(d) Use of adaptive time step control in transient analysis

Q6. A linear AC circuit having a voltage controlled voltage source is given in figure Q6. It is required to compute the variation of V_2 with variation of all circuit elements.

(a) Determine the adjoint network model of the Voltage Controlled Voltage Source using the Tellegan's Theorem

(b) Draw the adjoint network model of the given circuit.

(c) Determine the sensitivity figures of all circuit elements.
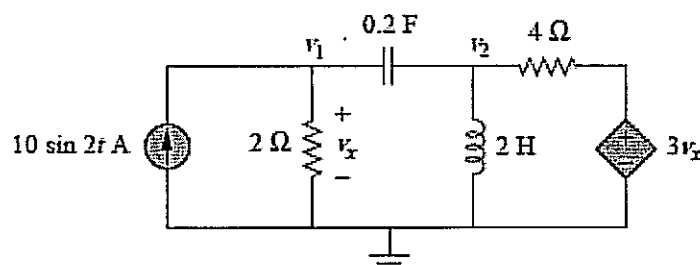

Figure Q6

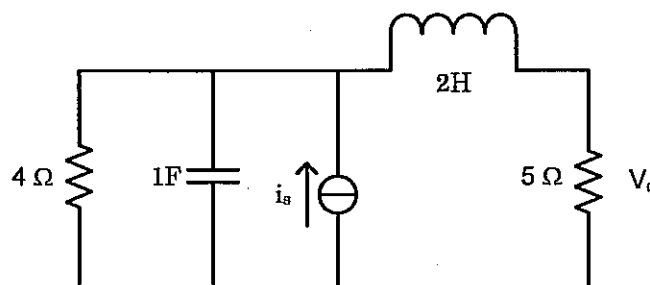Q7. A linear circuit containing two energy storage elements is given below.

Figure Q7

(a) Obtain the state space equations for the circuit

(b) Determine the transfer function between the current source and voltage across the 5Ω resistor.

(c) Show an algorithm of a numerical method used to obtain transient solution to a state space model.

Q8. There are number of algorithms that are used to simulate non linear circuits, each of which may have its own strengths and weaknesses.

(a) List non linear simulation techniques used in circuit simulation other than use of companion network models

(b) Draw the flow chart of one algorithm listed in answer of Q8.(a)

(c) Briefly explain advantages of the techniques given in Q8.(b) when compared with the other algorithms.

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