Course Code and Title: ELEC1001- Introduction to Electrical Systems

Programme: Bachelor of Applied Sciences

Date: May 6, 2013
Duration: 3 Hrs
Time: 9:00am – 12 noon

Read all instructions carefully before you begin this Examination.
Materials supplied

1. Question Paper
2. Answer Booklet

Instructions to Candidates

1. This paper has 5 pages and 6 questions.
2. You are required to answer ALL questions.
3. All questions do not have the same weighting.
4. You must return the question paper along with your answer booklet and other writing paper to the Invigilator at the end of the examination.

Key Examination Protocol

1. Students please note that academic dishonesty (or cheating) includes but is not limited to plagiarism, collusion, falsification, replication, taking unauthorised notes or devices into an examination, obtaining an unauthorised copy of the examination paper, communicating or trying to communicate with another candidate during the examination, and being a party to impersonation in relation to an examination.

2. The above mentioned and any other actions which compromise the integrity of the academic evaluation process will be fully investigated and addressed in accordance with UTT’s academic regulations.

3. Please be reminded that speaking without the Invigilator’s permission is NOT allowed.
1. Refer to Figure 1

![Figure 1](image)

a. Write the node voltage equations, and find $V_1$.
b. Hence, determine the current through $R_1$.
c. Convert the current source to a voltage source using source conversion.
d. Write the mesh current equations for the new circuit (choose clockwise mesh currents) and find the current through $R_1$.

(6, 3, 3, 5, 3) marks

2. Refer to Figure 2

a. In Figure 2(a), the Thevenin's resistance, $R_{th}$ with respect to terminals "ab", is 2 kΩ,

i. Find the value of $R$.
ii. Hence, determine using superposition voltage $V_0$
iii. Draw Thevenin's and Norton's equivalent circuits with respect to terminals "ab".

(4, 6, 2) marks
b. Refer to figure 2(b),
   i. Reduce the circuit in Fig 3 to one having a single voltage source in series with a resistance
   ii. Hence find the maximum power that resistor R can dissipate. 

   (6,3) marks

3. Refer to Figure 3

   a. Find the total impedance $Z_T$ in polar form
   b. Find the currents $I_1$, $I_2$, and voltages $V_{L2}$ and $V_C$ in phasor form
   c. Draw the phasor diagram of the voltages $E_1$, $V_{L2}$, $V_C$ and currents $I_1$ and $I_2$.
   d. Find the overall power factor of the circuit and indicate if it is leading or lagging.

   (4, 9, 4, 2) marks
4. Find the two elements of a series circuit if the instantaneous voltage is
   \( v = 42.43 \cos (377t + 45^\circ) \text{ Volts} \), the power is 300Watts and the power factor is 0.8 leading.

5. Refer to the network shown in Figure 4

   a. Find the current through each branch of the network.
   b. Hence, determine the total real, reactive and apparent powers in the network.
   c. What is the power factor of the network and state whether it is leading or lagging?
   d. Draw the power triangle.

   (8, 6, 2, 2 marks)
6. Semiconductors are the basic building blocks for diodes and transistors.

a. For the circuits shown in Figure 5 determine the voltage \( V_0 \) and the current through the resistor \( R \).

![Figure 5](image)

6 marks

b. For the circuit in Figure 6, \( I_B = 20 \ \mu A \), calculate
   i. The voltage \( V_B \).
   ii. The value of the resistances \( R_B \) and \( R_C \) if the transistor \( \beta = 100 \).

![Figure 6](image)

10 marks

END OF EXAMINATION