JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY

SCHOOL OF INFORMATICS AND INNOVATIVE SYSTEMS

DEPARTMENT OF COMPUTER SCIENCE AND SOFTWARE ENGINEERING

UNIVERSITY EXAMINATION FOR THE DEGREE OF BACHELOR SCIENCE IN COMPUTER SECURITY AND FORENSICS

1ST YEAR 2ND SEMESTER 2016/2017 ACADEMIC YEAR

MAIN CAMPUS

COURSE CODE: IIT 3124

COURSE TITLE: CIRCUIT THEORY AND BASIC ELECTRONICS

EXAM VENUE: **STREAM: BSC COMP. SECURITY**

DATE: APRIL 2017 **EXAM SESSION:**

TIME: 2.00 HOURS

INSTRUCTIONS:

1. **Answer Question 1 (Compulsory) and ANY other two questions**
2. **Candidates are advised not to write on the question paper**
3. **Candidates must hand in their answer booklets to the invigilator while in the examination room**

QUESTION ONE **[30 MARKS]**

(a) Distinguish between the following as applies to circuit theory. [8 Marks]

(i) Equivalence Resistance and Equivalence Conductance

(ii) Nodal Analysis and Mesh Analysis

(iii) Field Effect Transistors and Bipolar Junction Transistors

(iv) Ideal Operational Amplifier and Special-purpose Amplifier

(b) Determine the total charge entering a terminal between t = 1s and t = 3s if the current passing the terminal is $i = (3i^2-t)$A. [3 Marks]

(c) A voltage source of $20\sin\pi t$V is connected across a 5-kΩ resistor. Calculate the current through the resistor and the power dissipated. [4 Marks]

(d) State the **two** Kirchhoff's laws and in each, state the law in which they are built from. [4 Marks]

(e) Using a suitable circuit diagram, prove that a network with *b* branches, *n* nodes, and *l* independent loops satisfies the fundamental theorem of network topology: ***b = l + n -1***. [5 Marks]

(f) Using a function *f(t)*, explain your understanding of **Laplace transform**. Give one significance of Laplace transforms in circuit theory. [3 Marks]

(g) A certain 7805 regulator has a measured no-load output voltage of 5.18V and a full-load output of 5.15V. Express the load regulation in percentage. [3 Marks]

QUESTION TWO **[20 MARKS]**

(a) Using a suitable example, define the following terms as applies to circuit theory. [4 Marks]

(i) Circuit element

(ii) Open Circuit

(iii) Supernode

(iv) Tee Network

(b) Give **two** reason that can guide the choice of method to be used in analyzing a complex network. [2 Marks]

(c) Using a suitable example, demonstrate how one can convert: [8 Marks]

(i) Wye Network to Delta Network

(ii) Delta Network to Wye Network

(d) Name the steps required for determining the node voltages and mesh currents. [6 Marks]

QUESTION THREE **[20 MARKS]**

(a) Differentiate between the following as applies to circuit theory: [8 Marks]

(i) Linearity Principle and Superposition Principle

(ii) Thevenin's Theorem and Norton's Theorem

(b) When connected to a 4-Ω resistor, a battery has a terminal voltage of 10.8 V but produces 12 V on an open circuit. Determine the Thevenin's equivalent circuit for the battery. [4 Marks]

(c) A transducer is modeled with a current source I_x and a parallel resistance R_x. The current at the terminals of the source is measured to be 9.975 mA when an ammeter with an internal resistance of 20Ω is used.

(i) If adding a 2-kΩ resistor across the source terminals causes the ammeter reading to fall to 9.876 mA, calculate I_x and R_x. [5 Marks]

(ii) Determine the ammeter reading if the resistance between the source terminals is changed to 4 kΩ. [3 Marks]

QUESTION FOUR **[20 MARKS]**

(a) Explain the three groups in which materials used in electronics can be classified. [6 Marks]

(b) Name and explain the two types of extrinsic semi-conductors that are the key building blocks to electronic devices. [4 Marks]

(c) Explain how *forward bias* and *reverse bias* have significant effect on the operation of a diode. [4 Marks]

(d) Comment on the power rating for a case where forward current is 800mA and the forward voltage is 0.75V in a 1N4005. [2 Marks]

(e) Describe how MOSFET are used in digital applications. [4 Marks]

QUESTION FIVE **[20 MARKS]**

(a) Differentiate between the following terms as applies to operational amplifier: [4 Marks]

(i) Integrators and Differentiators

(ii) Summing Amplifier and Difference Amplifier

(b) Give the three characteristics of an ideal op amp. [3 Marks]

(c) Design an op amp circuit with inputs v_1 and v_2 such that $v_0 = -10v_1 + 6v_2$. [4 Marks] An averaging amplifier is a summer that provides an output equal to the average of the inputs. By using proper input and feedback resistor values, one can get

$$-v_{out} = \tfrac{1}{4}(v_1 + v_2 + v_3 + v_4)$$

Using a feedback resistor of 12 kΩ design an averaging amplifier with four inputs. [5 Marks]

(e) The open-loop gain of an op amp is 10,000. Determine the output voltage when there are inputs of +10μV on the inverting terminal and +20μV on the Noninverting terminal. [4 Marks]

- **END –**