COLLEGE OF ENGINEERING AND APPLIED SCIENCES (CEAS)

NCSC 116: FUNDAMENTALS OF DIGITAL ELECTRONICS

END OF SECOND SEMESTER EXAMINATIONS

APRIL 2025

LECTURER: MR B. MUKHALELA

DURATION: 3 HRS

INSTRUCTIONS TO CANDIDATES

1. This paper carries **6** questions.
2. Answer any **4 (four)** from **this** Question Paper **using Exam provided Answer booklet.**
3. Each question carries **25 marks**.
4. The marks for each question are indicated in square **[]** brackets.

Question 1 **[25 marks]**

a. Showing your workings, convert the following binary digits into their base 10 equivalence:
   I. 100101 [3]
   II. 100011 [3]
b. Showing your workings, convert the following base 10 numbers into their binary equivalence:
   i. 857 [3]
   ii. 73 [3]
c. You have decided to include both Active and Passive components on a PCB you are designing. Explain briefly what and why including such components on your PCB, cite examples. [6]
d. A great deal of technical effort has gone into producing A/D converters (ADCs) which are fast, accurate, and cheap. As an aspiring entrepreneur in the digital electronics space, explain how D/A converters (DACs) are a potential investment area as most economies are fast digitizing their economies in southern Africa. [7]

Question 2 **[25 marks]**

a. An Apprentice Digital Electronics Technician whom you worked with during a maintenance task suggested the following components to be looked into (troubleshoot): Capacitor, Resistor and Coil as he was suspecting them to be faulty. Now do the following;
   i. Draw the symbol used in basic electronics to represent each of the mentioned components. [6]
   ii. For each of the identified components, explain briefly how you as a professional in the digital electronic industry would tell that the components identified are faulty. [9]
b. Briefly explain what you will use the following basic testing pieces of equipment:
   i. Multimeter
   ii. ESR meter
   iii. Oscilloscope
   iv. Capacitance
   v. Ohm meter
   vi. Spectrum analyzer. [10]

Question 3 **[25 marks]**

a. Write the expression of equivalent resistance for ‘n’- number of resistors in series connection. [2]
b. Write the expression of equivalent resistance for ‘n’- number of resistors in parallel connection. [2]

c. State the Ohm's law. [1]

d. Let's say a friend asks you to fit a red warning light into the dashboard of his or her car. Being an electronics enthusiastic you decided to use a red LED because they produce reasonably pure red light, don't give off the excessive heat of filament lamps, they are also cheap by comparison and they look high-tech. Using a sketch diagram show the arrangement of the components, ie Resistor, LED and Battery in a simple circuit. [6]

e. You have been given a 9-volt circuit which draws 1.5 amps of current. You want to know if a transformer with a rating of 9V at 25VA will be adequate to power your circuit. Using these details, find out what the available current (I) will be. Moreso indicate some of the safety measures you should consider so as to safe guard the transformer in the circuit. [8]

f. You have decided to start your own mobile phone PCB designing company, which method of components mounting will you opt for and why? [3]

g. Why are NAND and NOR gates called universal gates? Justify your answer with the help of examples. [3]

h. Draw the circuit symbol and the associated truth table for the following:
    a. a tristate noninverting buffer with an active HIGH ENABLE input;
    b. a tristate inverting buffer with an active LOW ENABLE input; [6]

Question 4 **[25 marks]**

Using free hand, draw the following Logic gates and produce their truth tables;

NOT

AND

NAND

OR

NOR

XOR

XNOR [25]

Question 5 **[25 marks]**

a. Discuss briefly some of the Safety precautions you should observe or check on when working in an electronic Laboratory on the following:

(i) The Building

(ii) The Equipment and

(iii) On yourself. [6]

b. Define, Identify and briefly explain the key components of a Microcontroller. [6]

c. Reflect on the Incubator Project done over the Semester: Write a **Micro Python code snippet** for an ESP32 Microcontroller to control:

- A **relay switches on a heater** when temp < 37°C. [2]
- A **buzzer alarms** if temp > 40°C. [2]
- an Actuator (Turning Motor) for turning the Egg trays after every 90 minutes [2]

d. Assuming you have a microcontroller with GPIO pins, how would you:
- Connect the LEDs to the microcontroller [3]

e. Identify and explain briefly some of the applications of AC/DC converters in Digital Electronics. [4]

End of Examination