INTERNATIONAL UNIVERSITY OF EAST AFRICA
'Learning to Succeed'

FACULTY OF ENGINEERING

END OF SEMESTER EXAMINATIONS - APRIL 2025

PROGRAMME: DIPLOMA IN ELECTRICAL AND CONTROL ENGINEERING

YEAR/SEM: YEAR 2/SEMESTER 2

COURSE CODE: DEE2201

NAME: ELECTRONICS III

DATE: 2025-04-16

TIME: 9:00AM-12:00PM

INSTRUCTIONS TO CANDIDATES:

1. Read the instructions very carefully
2. The time allowed for this examination is STRICTLY three hours
3. Read each question carefully before you attempt and allocate your time equally between all the Sections
4. Write clearly and legibly. Illegible handwriting cannot be marked
5. Number the questions you have attempted
6. Use of appropriate workplace examples to illustrate your answers will earn you bonus marks
7. Any examination malpractice detected will lead to automatic disqualification.

DO NOT WRITE ANYTHING ON THE QUESTION PAPER

Section A Answer ANY THREE (3) questions in this section.

Question 1:

a) Highlight the significance of number systems in the area of digital systems. **(3 Marks)**

b) The 2's complement is a binary number system that represents signed integers on computers. It's the most common way to represent fixed point binary values and signed integers.

(i) Subtract 00000111 from 11111001 using the 2's complement. **(3 Marks)**

(ii) Suppose that n=8, solve the following number using 2's complement (-53-29) **(5 Marks)**

c) Perform the following conversions

(i) $(12.625)_8$ to binary **(3 Marks)**

(ii) $80F_{Hex}$ to octal **(3 Marks)**

(iii) $(101001010.010101)_2$ to octal **(3 Marks)**

Question 2:

a) John, a medical personnel working at Mengo hospital has just bought an X-ray machine. He has been advised to look for its datasheet. Briefly explain to him what a datasheet is and its importance? What basic information can be obtained from the datasheet? **(8 Marks)**

b) Determine the approximate frequency and hence period of a Schmitt-trigger oscillator that uses a 74LS14 with R = 15 kΩ and C = 0.005 μF. **(4 Marks)**

c) List the main components of the 555 timer. For the 555 Timer Oscillator, Calculate the value of R_A and R_B so that the oscillator has a frequency of 3.2 KHz and 85% duty cycle. Use C= 0.47 μF. **(8 Marks)**

Question 3:

a) Differentiate between Analog and Digital systems. Hence, give reasons why Digital systems are preferred to Analog systems. **(4 Marks)**

b) Subtract 11111 from 1010011. (Binary Subtraction) **(3 Marks)**

c) Draw the circuit diagram to implement the expression $x = (A+B)(\overline{B}+C)$? **(4 Marks)**

d) Draw the truth table and logic symbol for the following gates; **(9 Marks)**

(i) AND gate

(ii)OR gate

(iii)XOR gate

Question 4:

a) Design a logic circuit that has three inputs X, Y and Z and whose output will be HIGH only when a majority of the inputs are HIGH. **(8 Marks)**

b) What is a register? Hence, differentiate between serial and parallel data transfer. **(4 Marks)**

c) Relaxation oscillators are employed in generating non sinusoidal waveforms such as pulses with different characteristics. With reference to the above statement, use illustrations to define the following parameters of a pulse waveform. **(8 Marks)**

(i) Mark to space Ratio

(ii) Pulse repetition time

(iii) Pulse repletion frequency

Section B Answer ANY TWO (2) questions in this section.

Question 1:

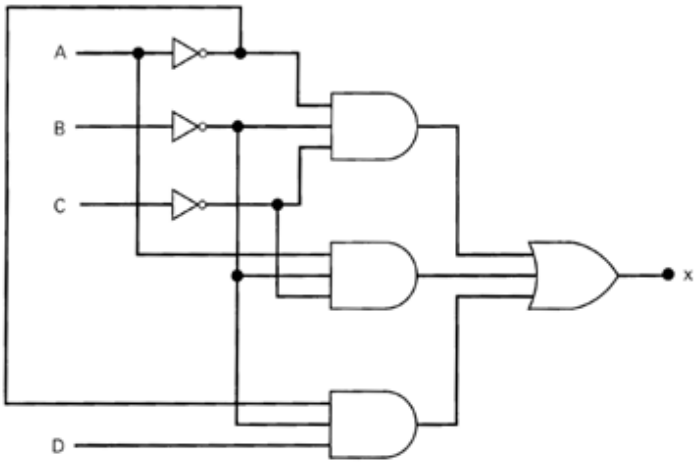
a) (i) How many nibbles are contained in six (6) bytes? **(3 Marks)**

(ii) Suppose that n=8 and the binary pattern is 10010101B, solve the value of this signed integer in 1's complement. **(3 Marks)**

b) Describe how a NOT gate works and its effect on a signal. **(4 Marks)**

c) Why do we use powers of 2 when counting in digital systems. **(3 Marks)**

d) Consider the circuit below designed to produce an output from four inputs as shown below.



(i) Give the expression of the output **x** and hence, simplify this expression. **(4 Marks)**

(ii) State **three (3)** reasons to justify the simplification of Boolean expressions during circuit design **(3 Marks)**

Question 2:

a) i). Why are flip-flops important in digital systems? Which two types of gates can be used to make flip-flops? **(3 Marks)**

ii). With the aid of neat illustrative diagrams, differentiate between setting and clearing the flip-flop (FF). **(6 Marks)**

b) Explain the difference between a level-triggered and an edge-triggered flip-flop. **(4 Marks)**

c) What is a clocked J-K flip flop? What improvement does it have over a clocked R-S flip flop? **(3 Marks)**

d) Explain why a ripple counterâ??s maximum frequency limitation decreases as more flip-flops are added to the counter. **(4 Marks)**

Question 3:

a) You are tasked with writing a program to convert a hexadecimal number to binary. Explain the steps and provide an example with the number A7. **(10 Marks)**

b) A four-bit binary number is represented as $A_3A_2A_1A_0$, where A_3, A_2, A_1, and A_0 represent the individual bits and A_0 is equal to the LSB. Design a logic circuit that will produce a HIGH output whenever the binary number is greater than 0010 and less than 1000. **(10 Marks)**

Question 4:

a) Distinguish between synchronous and asynchronous digital systems. Hence which type of flip-flop is best suited for synchronous transfer and why? **(5 Marks)**

b) What is a flip-flop? Show the logic implementation of an S-R flip-flop having active HIGH R and S inputs. Draw its truth table and mark the invalid entry. **(6 Marks)**

c) Define setup time and hold time, and explain why they are critical parameters in the design of flip-flop circuits. **(6 Marks)**

d) Explain the process of simplification using Boolean algebra and provide a real-world application where simplifying Boolean expressions would be useful. **(3 Marks)**