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: DEE2202

NAME: ANALOGUE & DIGITAL ELECTRONICS

DATE: 2025-04-14

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) 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 counter's maximum frequency limitation decreases as more flip-flops are added to the counter. **(4 Marks)**

Question 2:

a) **Write 'TRUE' if the statement is true and 'FALSE' if the statement is false. (5 Marks)**
   (i) Forward bias permits full current through a pn junction.
   (ii) The coded group of pulses in a digital electronic circuit consists of a series of HIGH and LOW voltages.
   (iii) Electrons are the minority carriers in an *p*-type material.
   (iv) Most of the input signals applied to a computer for storage or processing are digital in nature
   (v) The forward biased characteristics of a zener diode are the same as those of a diode.

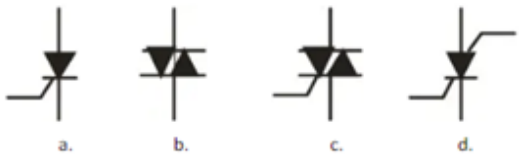
b) How can you use De-Morgan's laws to simplify the expression for an OR gate in terms of NAND gates? **(6 Marks)**

c) Perform the following conversions
   (i) 26.2_{Octal} to hexadecimal. **(3 Marks)**
   (ii) $A3F_{16}$ to binary. **(3 Marks)**
   (iii) $(101001010.010101)_2$ to octal. **(3 Marks)**

Question 3:

(a) Differentiate between controlled and uncontrolled rectifiers. **(4 Marks)**
(b) What causes power losses that occur in a thyristor during working conditions? **(4 Marks)**
(c) Discuss the conduction process of an SCR based on the two transistor model. **(6 Marks)**
(d) The SCR turn-off poses more problems than SCR turn-on. It is because once the device is ON, the gate loses all control. Briefly explain any two (02) SCR turn-off methods that you know. **(6 Marks)**

Question 4:



a) Refer to the figure above. For each of the above symbols, name the device it represents. **(4 Marks)**

b) Define Biasing and hence differentiate between forward and reverse biasing. **(6 Marks)**

c) Digital Integrated Circuits (**ICs**) are electronic devices that combine multiple digital components onto a small semiconductor chip to perform a specific function.

(i) Give three (3) most common internal failures of digital Integrated Circuits. **(3 Marks)**

(ii) State any three (3) causes of open signal lines in digital circuits. **(3 Marks)**

(iii)Explain two (2) steps involved in fixing a digital system that has a fault. **(4 Marks)**

Section B Answer ANY TWO (2) questions from this section

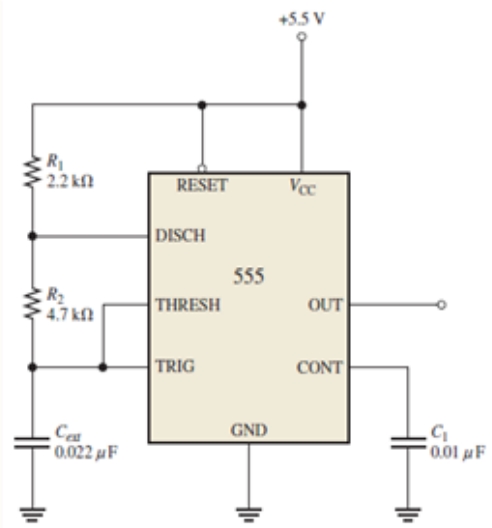
Question 1:

a) State any three advantages of the Unijunction Transistor (UJT) that make it an important device. **(3 Marks)**

b) With reference to the P-N Junction diode, explain the process leading to the formation of the depletion region. **(5 Marks)**

c) 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? **(5 Marks)**

d) List the main components of the 555 timer. Consider a 555 timer connected to operate in astable mode as shown below. Determine the frequency of the output and the duty cycle. **(7 Marks)**



Question 2:

a) What is the main difference between **BCD and binary** representation of numbers? **(4 Marks)**

b) Convert the decimal number **374** to **BCD** code. **(4 Marks)**

c) Subtract $(110101)_2$ from $(1011100)_2$ **(4 Marks)**

d) Determine the minimum expression for the Karnaugh map below. **(8 Marks)**

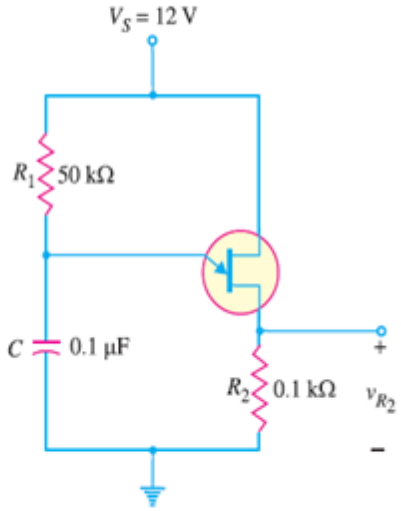
	$\bar{C}\bar{D}$	$\bar{C}D$	CD	$C\bar{D}$
$\bar{A}\bar{B}$	1	1	0	1
$\bar{A}B$	1	1	0	1
AB	1	1	0	1
$A\bar{B}$	1	1	1	1

Question 3:

a) What is the difference between a TRIAC and a DIAC in terms of their operation and in which application are they used? **(5 Marks)**

b) A Unijunction Transistor has 12 V between the bases. If the intrinsic stand-off ratio is 0.65, find the value of the stand-off voltage. What will be the peak-point voltage if the forward drop in the pn junction is 0.7 V? **(5 Marks)**

c) The figure shows the relaxation oscillator. The parameters of the UJT are $R_{BB} = 5\ K\Omega$ and $\eta = 0.68$.



(i) Determine R_{B1} and R_{B2} at $I_E = 0$ **(2 Marks)**

(ii) Calculate the voltage V_p necessary to turn on the UJT **(4 Marks)**

(iii) Determine the frequency of oscillations **(4 Marks)**

Question 4:

a) Define the setup time and hold time requirements of a clocked flip-flop. **(4 Marks)**

b) Perform the following conversions **(10 Marks)**

(i) $24CE_{Hex}$ to octal

(ii) $17E.F6_{Hex}$ to binary

(iii) 512.74_{octal} to binary

c) What is the difference between serial and parallel transfer? Explain how to convert serial data to parallel and parallel data to serial. What type of register is needed? **(6 Marks)**