TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering and Technology

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

UNIVERSITY EXAMINATION FOR:

DIPLOMA IN ELECTRICAL AND ELECTRONIC ENGINEERING (DEEE2)

DIGITAL ELECTRONICS I

EEE 2102

END OF SEMESTER EXAMINATION

SERIES: MAY 2016

TIME: 2 HOURS

DATE: Pick DateSelect MonthPick Year

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of **five** Questions;. Attempt any THREE Questions.

Do not write on the question paper.

QUESTION ONE

a. Define the term radix. (2 marks)

b. Carry out the following conversions.

(i) 10111.11_2 to octal.
(ii) $ADE2_{16}$ to binary.
(iii) 72.125_{10} to binary.
(iv) 50.025_{10} to Octal. (10 marks)

c. Perform the following binary arithmetic operations:

i. 1110111 + 1101110. (2 marks)
ii. 88 + 52 in BCD. (2 marks)

iii. DB + F5 (2 marks)
iv. 1110100 ÷100. (2 marks)

QUESTION TWO

(i) Work out:
   i. $32_{10} - 47_{10}$ using 2's compliment.
   ii. $16_{10} - 14_{10}$ using 1's compliment. (8 marks)

(ii) Distinguish between weighted and unweighted code and give an example of each. (4 marks)

(iii) Use the ASCII table attached to decode the following sequence.

1001001 1010000 1000001 1000100 0111111 (3 marks)

(iv) Encode the following characters using ASCII table:

a. ?

b. <

c. $ (3 marks)

(v) Convert the binary code 1111001100 to gray code. (2 marks)

QUESTION THREE

a. Three sensors are used to monitor pressure **P**, temperature **T**, and voltage **V** of an industrial plant. An alarm **X** should sound for the following conditions:

- If both temperature and voltage sensors are **OFF**.
- If temperature sensor is **ON** and voltage sensor is **OFF**.
- If pressure sensor is **OFF** and voltage sensor is **ON.**

Take **ON** = Logic **1**

OFF = Logic **0**

Required:

i. Develop a truth table for the problem.

ii. Obtain the Boolean expression relating **PTV** and **X**.

iii. Minimize the expression using Karnaugh Map.

iv. Implement the minimized expression using basic gates. (11 marks)

b. State four applications of Logic gates. (4 marks)

c. Two electrical signals represented by $A = 101101$ and $B = 110101$are applied to a 2-input AND gate. Sketch the output signal and the binary number it represents. (3 marks)

d. State Demorgans theorem. (2 marks)

QUESTION FOUR

(i) An office building has an elevator system consisting of three elevators **A, B** and **C. A** logic circuit is required that will provide an alarm any time **TWO** of the three elevators is in use.

i. Draw the truth table to satisfy the given conditions.
ii. Derive the expressions for the sum of products. (4 marks)

(i) Give the following logic expression as a function of minterms and hence simplify using a K-map.

$Z = A\bar{B} + \bar{A}CD + \bar{A}\bar{B}C + A\bar{B}C\bar{D}$ (4 marks)

(ii) Draw the table of gray code against the decimal 0-9. (3 marks)

(iii) Prove the following Boolean identities:

i. $XZ + XYZ = XZ$

ii. $X + \bar{X}Y = X + Y$

iii. $XYZ + X\bar{Y}Z + XY\bar{Z} = X(Y + Z)$ (7 marks)

(iv) Simplify the following expressions using Boolean Algebra: (2 marks)

a) $A = \overline{(\overline{W + X}) + (\overline{Y + Z})}$

b) $B = \overline{(X + \bar{Y})} + \overline{(XY)}$

QUESTION FIVE

a. The correct functioning of a machine is monitored by three **LED** indicators named **A**, **B**, and **C**. the machine is working if one of the following conditions holds.

- **ALL LED** are Red.
- **A** is red and either **B** or **C** is green.
- **C** is red and **A** is green.

i. Draw the truth table and produce a Boolean expression to represent when the machine is working. (4 marks)

ii. Implement the expression in (i) above using basic gates only. (4 marks)

b. Draw the table of **excess -3 code** against the **decimal 0-9.** (3 marks)

(i) Design from first principles the full adder binary circuit using logic gates. (6 marks)

(ii) What are asynchronous inputs of a flip flop? (1 mark)

(iii) Give **two** examples of non-saturated logic families. (2 marks)