TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ENGINEERING & TECHNOLOGY

DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING

UNIVERSITY EXAMINATION FOR:

THIRD YEAR SECOND SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF TECHNOLOGY AND APPLIED PHYSICS

EEE4350: DIGITAL ELECTRONICS & DEVICES

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 **Question ONE (Compulsory)** and any other **TWO Questions**

Do not write on the question paper.

Question ONE

a. State with reasons, which of the following systems are analog and which are digital.

i. Pressure gauge

ii. Transistor radio receiver

iii. Electronic Voting Machine

iv. Clinical thermometer

v. An electronic counter used to count persons entering an exhibition

(5 marks)

b. Define the following terms

i. Fan-out

ii. Parity bit (2 marks)

c. With the aid of symbol, logic diagram and truth table, explain the operation of a JK flip-flop

(8 marks)

d. Draw the combinational circuit that directly implements the following Boolean expression:

$$Y(x, y, z) = (xyXOR(y + \bar{z})) + \bar{x}z$$

(4 marks)

e. Perform the following conversions:
   i. 1011001.1010_2 to Hexadecimal
   ii. 94.3_{10} to BCD code
   iii. 197_{10} to Octal
   iv. 11010101010_2 to Gray
   v. 6563_8 to binary to Hexadecimal

(5 marks)

f. Expand the following Boolean expression

$Y = A \oplus B \oplus C$

(6 marks)

Question TWO

a. Design a sequence generator to repeatedly generate the sequence $\cdots 11010 \cdots$ (10 marks)

b. In a 4-stage ripple counter, the propagation delay of a flip-flop is 50 ns. If the pulse width of the strobe is 30 ns, find the maximum frequency at which the counter operates reliably. (2 marks)

c. Find the decimal equivalent of the following binary numbers assuming sign-magnitude representation of the binary numbers.

   i. 101100

   ii. 001000 (2 marks)

d. Minimize the following logic function and realize using NAND gates only:

$$Y(ABCD) = \sum m(1,3,5,8,9,11,15) + d(2,13)$$ (6 marks)

Question THREE

a. Describe any **FOUR** characteristics of TTL logic family (8 marks)

b. With the aid of a logic diagram, explain the operation of a decade counter.

(12 marks)

Question FOUR

a. Define a K-Map and cell adjacency (2 marks)
b. Use a K-Map to simplify the following expression:

$Y(ABCD)=\bar{A}\bar{B}\bar{C}D+AB\bar{C}D+A\bar{B}\bar{C}D+\bar{A}\bar{B}CD+\bar{A}BCD$ (6 marks)

c. i. State the meaning of the terms Maxterm and Minterm as applied to digital logic
   ii. Reduce the following function using K-Map and draw the logic circuit

$$Y(ABCD)=\sum mi(0,1,2,3,5,7,8,9)$$ (8 marks)

d. Define the following laws as used in Boolean Algebra

i. Commutative law
ii. Associative laws
iii. Distributive law
iv. DeMorgan's law

(4 marks)

Question FIVE

a. Tyrone Shoelaces has invested a huge amount of money into the stock market and doesn't trust just anyone to give him buying and selling information. Before he will buy a certain stock, he must get input from three sources. His first source is Pain Webster, a famous stock broker. His second source is Meg A. Cash, a self-made millionaire in the stock market, and his third source is Madame LaZora, a world-famous psychic. After several months of receiving advice from all three, he has come to the following conclusions:

i. Buy if Pain and Meg both say yes and the psychic says no.
ii. Buy if the psychic says yes.
iii. Don't buy otherwise.

Construct a truth table and find the minimized Boolean function to implement the logic telling Tyrone when to buy. Implement the minimized Boolean function.

(6 marks)

b. Define the term 'Universal Gate' (2 marks)

c. Show how a NAND gate can be used to realize an XOR gate (4 marks)

d. Apply De-Morgan's theorem to the function below

$$F = \overline{AB + B\overline{C}D + A\overline{B}C}$$

(4 marks)

e. Draw the logic circuit arrangement of the Boolean expression below

$$Y = \overline{\left(AB + \overline{B}C\right)}\left(\overline{AB}\right)\left(\overline{A\overline{B} + BC}\right)$$ (4 marks)