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KIRIRI WOMEN'S UNIVERSITY OF SCIENCE AND TECHNOLOGY
UNIVERSITY EXAMINATION, 2024/2025 ACADEMIC YEAR
SECOND YEAR, FIRST SEMESTER EXAMINATION
FOR THE BACHELOR OF SCIENCE IN COMPUTER SCIENCE
KCS 206 – DIGITAL LOGIC & DESIGN

Date: 16TH April 2024
Time: 8:30AM – 10:30AM

INSTRUCTIONS TO CANDIDATES

ANSWER QUESTION ONE (COMPULSORY) AND ANY OTHER TWO QUESTIONS

QUESTION ONE (30 MARKS)

- a) Briefly describe the three characteristics of any working system? (6 Marks)
- b) What is the difference between radix complement and diminished radix complement? (2 Marks)
- c) Generate a truth table for the following Boolean function, $f(x, y, z) = x \cdot y + y \cdot z + \bar{z} \cdot y$ (4 Marks)
- d) Express the following Boolean expression in canonical form sum of products (SOP) notation and draw a truth table. (6 Marks)
- $$f(a, b, c) = \bar{a} \cdot \bar{b} \cdot c + \bar{a} \cdot b \cdot c + \bar{a} \cdot \bar{b} \cdot \bar{c} + \bar{a} \cdot b \cdot \bar{c}$$
- e) Explain why a computer is referred to as a digital system. (2 Marks)
- f) Explain the following terms as used in karnough map minimization technique in Boolean functions.
- i) Implicant. (1 Mark)
- ii) Prime Implicant (1 Mark)
- g) Convert the following numbers into their equivalent hexadecimal numbers.
- i) 323_8 (3 Marks)
- ii) 1001_8 (3 Marks)
- h) Define the following terms used in canonical and standard form
- i) Max-term (1 Marks)
- ii) Min-terms (1 Marks)

QUESTION TWO (20 MARKS)

- a) Explain two characteristics of each of the following number systems.
- i) Binary Number System
- ii) Octal Number System
- iii) Hexadecimal number System (3 Marks)
- b) Convert 101_{10} to its equivalent binary and octal number. (5 Marks)
- c) A digital circuit has three inputs **A**, **B** and **C**. Inputs **A** and **B** are applied to an **OR** gate. The output of the gate is applied to one input of **AND** gate. Input **A** and **C** is passed through a **OR** gate before being applied to the other input of the **AND** gate.
- i) Draw a logic diagram showing this output. (2 Marks)
- ii) Simplify the Boolean expression obtained above. (2 Marks)
- d) Using the truth table below, show the SOP expression and then minimize it using a K-map and draw the minimized circuit. (8 Marks)

x	y	z	f
0	0	0	1
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	1

QUESTIONS THREE (20 MARKS)

- a) Using an example relationship between min-terms and max-terms as used in canonical or standard form of functions (6 Marks)
- b) Show the truth table for the following four variable boolean function and simplify it using the karnaugh map. (10 Marks)
- $f(w,x,y,z) = \sum(0, 2, 5, 7, 8, 10, 13, 15)$
- c) Draw logic diagram for the above simplified boolean expression. (4 Marks)

QUESTION FOUR (20 MARKS)

- a) State four characteristics of 2's complement numbers. (4 Marks)
- b) Describe three ways in which you can obtain the two's complement of a given number. (6 Marks)
- c) Using each of the above-mentioned methods express **-45** into 8-bit 2's complement number (6 Marks)
- d) We have two types of adders in logic circuitry, full adder and half adder. Explain the difference between them. (4 Marks)

QUESTION FIVE (20 MARKS)

- a) Explain full adder and draw its logic diagrams build from combination of two half –adders.(8 Marks)
- b) State any two practical applications of adders. (2 Marks)
- c) Briefly explain step by step the process of minimizing a boolean expression using the karnaugh map (K-MAP) technique. (6 Marks)
- d) Using boolean algebra laws and theorems, proof the following boolean expression. (4 Marks)
- $A(\overline{A + B}) = A\overline{B}$