



MACHAKOS UNIVERSITY

University Examinations for 2020/2021

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF MATHEMATICS STATISTICS

SECOND YEAR FIRST SEMESTER EXAMINATION FOR

DIPLOMA IN ELECTRICAL AND ELECTRONIC ENGINEERING

2601/202D: DIGITAL ELECTRONICS

DATE: 30/8/2021

TIME: 8:30 – 10:30 AM

INSTRUCTIONS:

1. You should have an examination booklet for this examination
2. Answer **ALL** questions.
3. Maximum marks for each part of a question are as shown.

QUESTION ONE COMPULSORY (20 Marks)

1. a) (i) Convert the following numbers as instructed:

- 573_8 to binary;
- $ADE96_{16}$ to decimal.

(ii) Perform the following operations:

- Add BCD numbers 23 and 18
- Convert gray code 11110001011 to binary.

(10 marks)

b) A chemical processing plant uses four sensors A, B, C, and D to control the conveyor belt at the packing bay. The conveyor belt will move when any of the following conditions are met.

- (i) ALL sensors are low;
- (ii) ONLY one sensor output is high;
- (iii) Sensor A and D are low; B C are high;
- (iv) Sensor A and D are high; B C are low.

- Draw a truth table to represent these conditions;
- Deduce a Boolean expression from the truth table and reduce it using a K – map;
- Implement this control circuit using logic gates.

(10 marks)

2. a) (i) Express the following decimal number into 8421 BCD;

(8752)₁₀

(2 marks)

(ii) Using the 8421 BCD arithmetic, perform the following operation of decimal numbers

125 + 235

(4 marks)

(iii) Express the following XS – 3 number in decimal;

1110111100

(2 marks)

(iv) Perform the following conversions;

- 1101011 binary to gray code
- 01100000 BCD to XS – 3

(2 marks)

b) (i) Name the **seven** logic gates used in digital systems.

(7 marks)

(ii) Table 1 shows the classification of logic families:

Table 1

Category	Number of equivalent basic logic gates on a single chip
1	12 – 99
2	100 – 999
3	10,000 and above

Name the corresponding category of the logic families.

(3 marks)

3. a) For the logic circuit in figure 1, prepare a truth table and hence obtain the output expression at Y.

(10 marks)

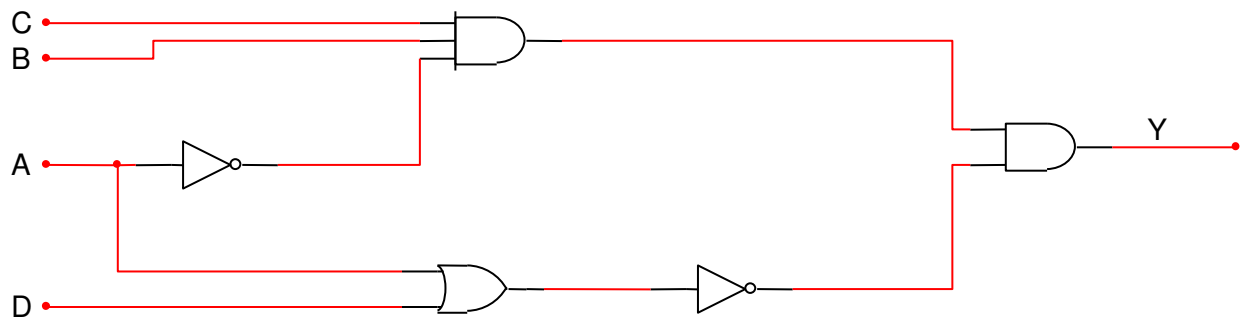


Figure 1

b) Differentiate between even and odd parity as used in error detection codes.

(4 marks)

c) Simplify using K map the following Boolean expression;

$$f(A,B,C,D) = \sum(0,1,2,3,4,5,6,7,8,9,12,13)$$

(6 marks)

4 a) staircase light is controlled by two switches S1 and S2. The output F is logic 1 if either of the switches is ON:

- Draw the truth table;
- Derive the logic expression from the truth table;
- Implement the circuit using NAND gates only.

(10 marks)

b) A digital system is to be designed with three switches ABC to control the operation of a motor.

The motor can run when;

- Switches A and B are ON
- Switches A and C are ON
- ALL switches are ON

Draw a simplified logic circuit diagram to facilitate this operation.

(10 marks)

5. a) With the aid of a truth table, verify that $M.(D + F) = M.D + M.F$ (4 marks)
- b) A Boolean function is represented by $F(A,B,C) = \sum(3,4,5,6,7)$. Using Boolean algebra simplify the function in sum – of – product (SOP) form. (6 marks)
- c) Use Quine MC Clusky method to minimize the function given by;
- $f(A, B,C,D) = \sum(0,5,6,9,10,13,14,15,7)$ (10 marks)