(*Knowledge for Development*)

KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS
2019/2020 ACADEMIC YEAR

SPECIAL/SUPPLEMENTARY EXAMINATIONS
YEAR ONE SEMESTER TWO EXAMINATIONS

FOR THE DEGREE OF
BACHELOR OF INFORMATION TECHNOLOGY

COURSE CODE : BIT124

COURSE TITLE : DIGITAL ELECTRONICS

DATE: 10/2/2021 **TIME: 10.00 A.M. -1.00 P.M**

INSTRUCTIONS TO CANDIDATES

ANSWER QUESTIONS ONE AND ANY OTHER TWO.

QUESTION ONE-COMPULSORY (30MARKS)

a) Define the following terms as used digital electronics.
   i) 1's Complement [1 mark]
   ii) 2's Complement [1 mark]

b) Convert the following the decimal number 539 into octal. [1 mark]

c) Convert hexadecimal number A37C. $3E_{16}$ to;
   i) Binary [2 marks]
   ii) Octal [2 marks]

d) Perform the following binary operations.
   i) $(0101011)_2 + (101011)_2$ [1 mark]
   ii) Add -15 to -9 using binary [2 marks]

e) Using K –map simplify following Boolean function of four variables; [3 marks]

$$F(A,B,C,D) = \sum (0,1,2,4,7,9,11,12)$$

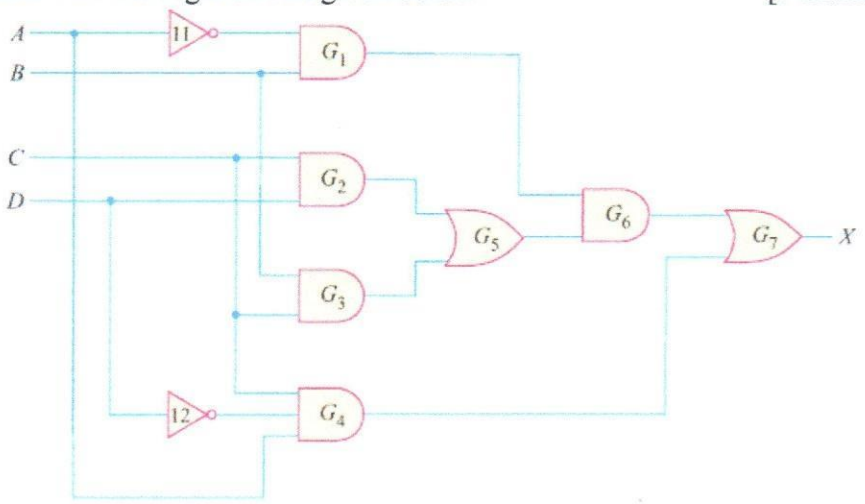
f) Simplify the following Boolean expression below [4 marks]

$$Y = A \cdot B \cdot \overline{C} \cdot \overline{D} + \overline{A} \cdot B \cdot \overline{C} \cdot \overline{D} + \overline{A} \cdot B \cdot C \cdot \overline{D} + A \cdot B \cdot C \cdot \overline{D}$$

g) Design the logic circuit for the result obtained in 1(f) above [2 marks]

h) Obtain a truth table for the minimized logic circuit in 1(f) above [3 marks]

i) Obtain the Boolean expression for the logic circuit given below [3 marks]



j) Simplify the following SOP expression using the Karnaugh mapping technique [5 marks]

$$X = B\overline{C}\,\overline{D} + \overline{A}\,B\,\overline{C}\,D + AB\overline{C}D + \overline{A}BCD + ABCD$$

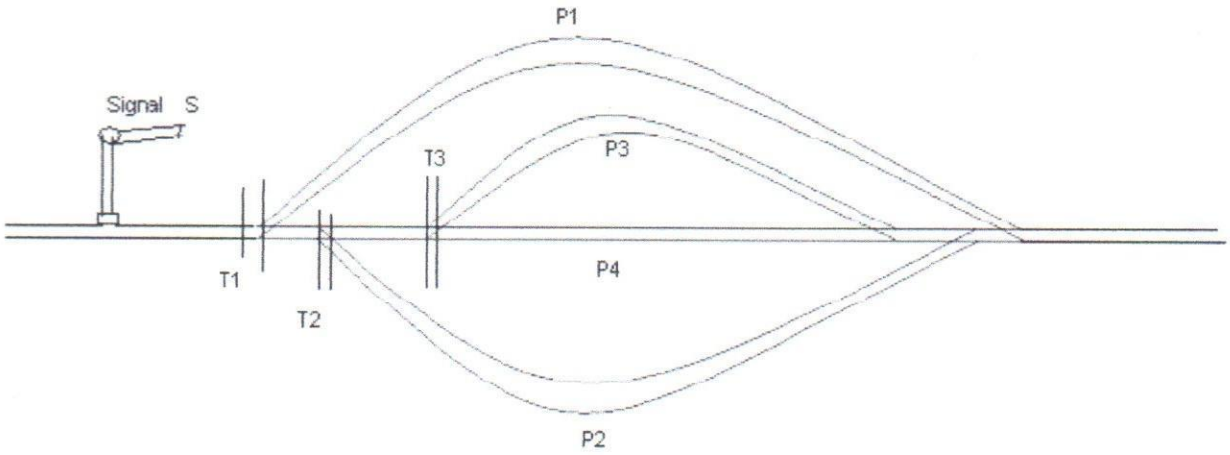
QUESTION TWO

a) Draw the block diagram of a 4-bit shift register using D flip-flops. [4 marks]

b) If initially all the flip-flop outputs in (a) above are in zero state, prepare the truth table when the input sequence is 1, 1, 0, 1, 0. [6 marks]

c) A railway station has four platforms marked as P1, P2, P3 and P4 as shown in the figure below. The trains can come only from left hand side and enter these platforms. The trains are to be routed to these platforms in the order of preference P1, P2, P3 and in the last to P4. Each platform has a switch will be turned ON if the platform is not empty. There is an outer signal S which will be either green or red. This signal will be green if it allows the train to enter the station otherwise red. There are three track changer switches T1, T2, T3 which allows changing the tracks. Design a railway track switching circuit using AND, OR and NOT gates, which can perform the operations mentioned above.

[10 marks]



QUESTION THREE

a) Prove that; [5 marks]

$$\overline{X}\,\overline{Y}\,\overline{Z}\,\overline{W} + \overline{X}\,\overline{Y}Z\overline{W} + X\overline{Y}\,\overline{Z}\,\overline{W} + \overline{X}ZW + X\overline{Y}Z\overline{W} = \overline{Y}\,\overline{Z} + \overline{X}ZW$$

b) Design a digital logic circuit to produce a 50 Hz output signal from an input signal of 3.2 KHz. [4 marks]

c) Differentiate between a multiplexer and a demultiplexer [3 marks]

d) Explain the operation of a demultiplexer circuit [4 marks]

e) Explain how a decoder is used in the following areas

i) Computer memory [2 marks]

ii) Input/Output device addressing [2 marks]

QUESTION FOUR

a) Explain the concept of square adjacency in Karnaugh map [3 marks]

b) Using appropriate logic circuit diagram design a MOD 6 counter [6 marks]

c) Derive the Boolean expression for the truth table shown below [3 marks]

INPUT				OUTPUT
A	B	C	D	X
0	0	0	0	1
0	0	0	1	1
0	0	1	0	1
0	0	1	1	0
0	1	0	0	0
0	1	0	1	1
0	1	1	0	0
0	1	1	1	0
1	0	0	0	1
1	0	0	1	1
1	0	1	0	1
1	0	1	1	0
1	1	0	0	0
1	1	0	1	0
1	1	1	0	0
1	1	1	1	0

d) Simplify the Boolean function obtained in (c) above to a minimum number of literals using the Karnaugh map [5 marks]

e) Implement the switching logic circuit for the resulting Boolean expression in 4(d) above [3 marks]

QUESTION FIVE

a) A logic signal is required to give an indication when:

- The supply to an oven is on, and
- The temperature of the oven exceeds 210°C, or
- The temperature of the oven is less than 190°C.

Devise a logic circuit using **NAND**-gates only to meet these requirements. [6 marks]

b) Discuss the main classes of logic families; [8 marks]

c) Describe any three applications of multiplexers [6 marks]