Information and Communications University.

School of Engineering

Department of Electrical/Electronics

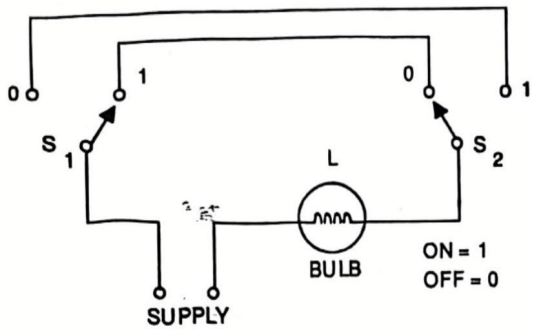
Digital/Electronics for Computing 1 Examination

December 2025

INSTRUCTIONS

- They are 12 questions answer All.
- Write your solutions as clean as possible.
- Enjoy

1. A staircase light is controlled by two switches S1 and S2, one at the top of the stairs and another at the bottom of the stairs. The circuit diagram of the system is shown.



(i) Make a truth table for this system.

(ii) Write the logic equation in SOP form.

(iii) Realize the circuit using AND-OR gates.

(iv) If a third switch S3 is added in the middle of the staircase such that the light can be controlled from any of the three switches, determine the new truth table, logic equation and logic circuit.

2. The figure below shows the results of a 7-segment display. answer the following questions.

Segments (✓ = ON)							Display	Segments (✓ = ON)							Display
a	b	c	d	e	f	g		a	b	c	d	e	f	g	
✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓		
	✓	✓						✓	✓	✓			✓		
✓	✓		✓	✓				✓	✓	✓		✓	✓		
	✓									✓	✓	✓			
											✓	✓	✓		
										✓	✓	✓			
											✓	✓			
												✓			

i. What is the primary function of a 7-segment display?

ii. Write the Boolean expression for all the segments (a) to (g) using a 4-variable k -map.

iii. Design logic circuits using basic gates (AND, OR, NOT) to activate each segment.

3. The information provided below is for designing the control logic for a smart greenhouse ventilation system. The system uses four environmental sensors to decide when to activate the main exhaust fan:

A: High Temperature Sensor (1 = Over 28°C)

B: High Humidity Sensor (1 = Over 80% RH)

C: Low Carbon Dioxide Sensor (1 = Below 400 ppm)

D: Rain Sensor (1 = Raining)

The exhaust fan (F) should turn ON for the following sensor combinations (minterms),

Fan Activation Codes: m (1, 3, 4, 5, 6, 7, 9, 12, 13)

For example:

m (4) is 0100, meaning: Normal Temp (A=0), High Humidity (B=1), High CO_2 (C=0), No Rain (D=0) → Fan ON.

m (7) is 0111, meaning: Normal Temp (A=0), High Humidity (B=1), Low CO_2 (C=1), Raining (D=1) → Fan ON.

where ABCD represents the 4-bit input with A as the MSB:

(i) Draw the 4-variable Karnaugh Map for the logic function F (A, B, C, D).

(ii) Identify and circle all the prime implicants (the largest possible groups of 1s).

(iii) Derive the simplified Boolean expression for F in Sum-of-Products (SOP) form.

(iv) Based on your simplified SOP expression, draw a logic circuit diagram using only AND, OR, and NOT gates.

(v) Using your simplified expression, determine if the fan should be ON or OFF for the condition: It is a hot, dry day with low CO_2. Justify your answer by showing the input values and your calculation.

4. Study the truth table carefully and fill the **output section** note the bold letters represents bar.

A	B	C	A+B.C	A.B+BC	A.B.C+ABC
0	0	0			
0	0	1			
0	1	0			
0	1	1			
1	0	0			
1	0	1			
1	1	0			
1	1	1			

5. Simplify the expressions using Boolean postulates

(i) $\overline{X\bar{Y} + XYZ + X(\bar{Y} + X\bar{Y})}$

(ii) $Y = (A + B)(\bar{A} + C)(B + C)$

(iii) $XY + \overline{XZ} + X\bar{Y}Z\,(XY + Z)$

6. Prove the following Boolean identities.

(i) $XY + YZ + \bar{Y}Z = XY + Z$

(ii) $A.B + \bar{A}.B + \bar{A}.\bar{B} = \bar{A} + B$

7. Reduce the following equation using k-map.

$$Y = \overline{ABC} + A\overline{CD} + A\bar{B} + ABC\bar{D} + \overline{A}\overline{B}C$$

8. The Karnaugh map for a SOP function is given below. Determine the simplified SOP Boolean expression.

AB \ CD	00	01	11	10
00	1	1		1
01		1		
11				
10	1	1		1

9. **a.** Convert the following decimal numbers to the indicated base,

i. 7562.45 to Octal

ii. 1918.25 to Hexadecimal

iii. 11517510 to Binary.

b. Convert the following binary numbers to decimal:

1001101. 1001 and 10101 11 0.1001.

c. What is the exact number of bits in a memory that contains

i. 48K bits ii. 354M bits: iii 8G bits?

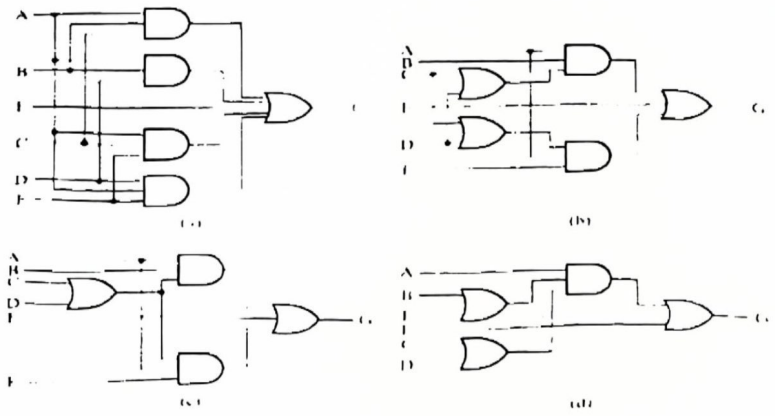
d. Show the bit configuration that represent the decimal number 365 in

i. binary. ii. BCD. iii ASCII,

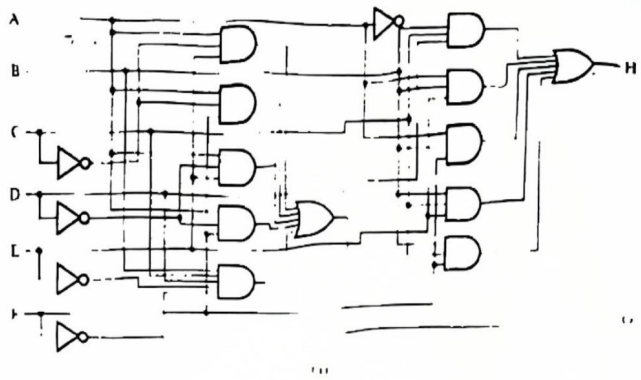
10. Convert the following numbers from the given base to the other three bases listed in the table:

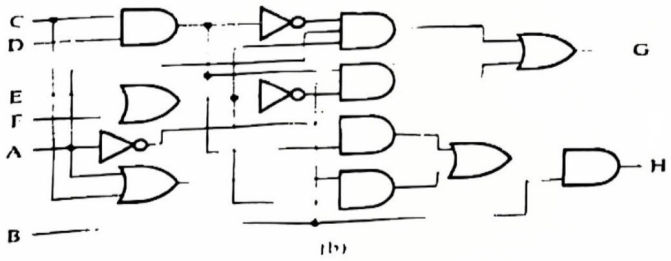
Decimal	Binary	Octal	Hexadecimal
369.3125	?	?	?
?	10111101.101	?	?
?	?	326.5	?
?	?	?	F3C7.A

11. Deduce the Boolean equation and write the truth table for each circuit given

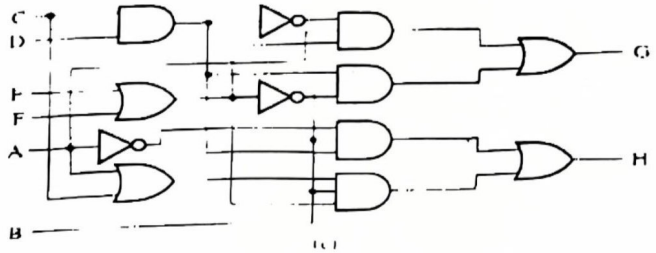


12. Given the logic circuits below, use the kap-map technique to come up with the equations and truth-table





(b)



(c)