1. **Q.** Draw the Karnaugh map and determine the minimum-cost SOP and POS expressions for the function $f(P,Q,R,S) = \sum m(0,2,5,7,8,10,13,15)$

2. **Q.** Draw the Karnaugh map and determine the minimum-cost SOP and POS expressions for the function $f(A,B,C,D) = \sum \Pi(3,5,7,8,10,11,12,13)$

3. **Q.** Write an SOP expression for this truth table, and then draw a gate circuit diagram corresponding to that SOP expression

   Then, simplify this expression using Boolean algebra techniques, and draw a simplified gate circuit diagram based on the final reduced expression.

A	B	C	Output
0	0	0	0
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

4. **Q.** Examine this truth table and then write both the SOP and POS standard Boolean expressions describing the output.

   Which of those Boolean expressions is simpler for this particular truth table? Which will be easier to reduce to simplest form (for the purpose of creating a gate circuit to implement it)?

A	B	C	Output
0	0	0	1
0	0	1	0
0	1	0	1
0	1	1	0
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	0

5. **Q.** Write a POS expression for the output corresponding to this truth table

A	B	C	Output
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	1

6. **Q.** Write an SOP Boolean expression for this truth table, then simplify that expression as much as possible, and draw a logic gate circuit equivalent to that simplified expression.

A	B	C	Output
0	0	0	1
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

7. **Q.** Write an SOP Boolean expression for this truth table, then simplify that expression as much as possible, and draw a logic gate circuit equivalent to that simplified expression.

A	B	C	Output
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	0
1	1	1	0

8. For questions 1-34, simplify each Boolean expression using the basic rules, De Morgan's Laws and any other relevant techniques as needed.

1) $(\overline{A}+B).(A+\overline{B})$

2) $A.B+B$

3) $A.B+A.\overline{B}$

4) $B.(A+\overline{A})$

5) $\overline{\overline{A}+\overline{B}.A}$

6) $\overline{1.B}$

7) $(\overline{A.B})+\overline{(A.\overline{B})}$

8) $\overline{A+B+\overline{A}}$

9) $A.(B+1)$

10) $(X+Y).(X+\overline{Y})$

11) $\overline{\overline{A}.\overline{B}}+A+\overline{B}$

12) $\overline{(\overline{A}+\overline{C})}.\overline{(A+B)}$

13) $\overline{(\overline{A+B}).\overline{(\overline{A}+C)}}$

14) $\overline{D.\overline{E}+\overline{E}.(D+\overline{D})}$

15) $\overline{D.(E+\overline{D})}$

16) $\overline{\overline{A}.B+A.\overline{(A+\overline{B})}}$

17) $B.(A+\overline{B})$

18) $\overline{\overline{D+\overline{E}}+\overline{E}}$

19) $(\overline{A}+A.B).\overline{B}$

20) $\overline{\overline{A}+\overline{B}}+B.\overline{A}$

21) $\overline{\overline{D}+\overline{E}}$

22) $\overline{X.\overline{Y}+\overline{X}.\overline{Y}+\overline{X}.Y}$

23) $\overline{B}.\overline{\overline{A}+\overline{B}}$

24) $\overline{\overline{D}+\overline{\overline{E}}}$

25) $X.(\overline{X}+Y)$

26) $\overline{\overline{A}.\overline{B}}$

29) $\overline{\overline{A}+\overline{B}}+A.\overline{B}$

30) $\overline{A}+\overline{B+A}$

31) $X+\overline{\overline{Y}.\overline{Z}}$

32) $\overline{\overline{X}.\overline{Y}}+\overline{X}$

33) $\overline{X.\overline{Y}+\overline{X}.\overline{Y}}$

34) $\overline{A.C+A.B+B.\overline{C}+\overline{A}.C}$