
LOGIC CIRCUITS

COMPUTER SCIENCE

Topic: Logic Circuits

Duration: 1 hour 20 minutes

INSTRUCTIONS

- Carry out every instruction in each task.
 - Answer **all** questions.
 - Use a black or dark blue pen.
 - You may use an HB pencil for any diagram, graphs or rough working.
 - **Calculator Not Allowed.**
 - Show your workings if relevant.
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INFORMATION

- The total marks for this paper is **60 marks**.
- The number of marks for each question or part question is shown in brackets [].

1. A system is monitored using sensors. The sensors output binary values corresponding to conditions, as shown in the table:

Parameter	Description of parameter	Binary value	Description of condition
P	Oil pressure	0	pressure \geq 3 bar
		1	pressure $<$ 3 bar
T	Temperature	0	temperature \geq 200 K
		1	Temperature $<$ 200 K
R	Rotation	0	rotation \leq 1000 rpm
		1	rotation $>$ 1000 rpm

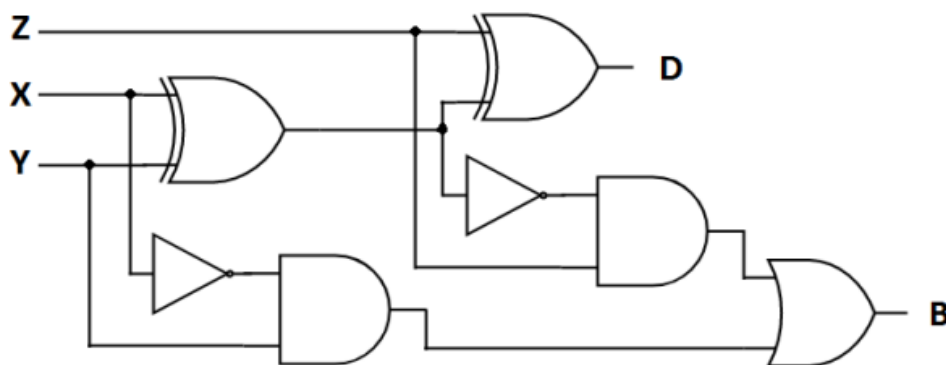
The outputs of the sensors form the inputs to a logic circuit. The output from the circuit, X, is 1 if any of the following conditions are met:

- Oil pressure \geq 3 bar and temperature \geq 200 K
- oil pressure $<$ 3 bar and rotation $>$ 1000 rpm
- temperature \geq 200K and rotation $>$ 1000 rpm

(a) Draw a logic circuit to represent the above system. [5]

(b) Draw and fill the truth table for the logic circuit. [4]

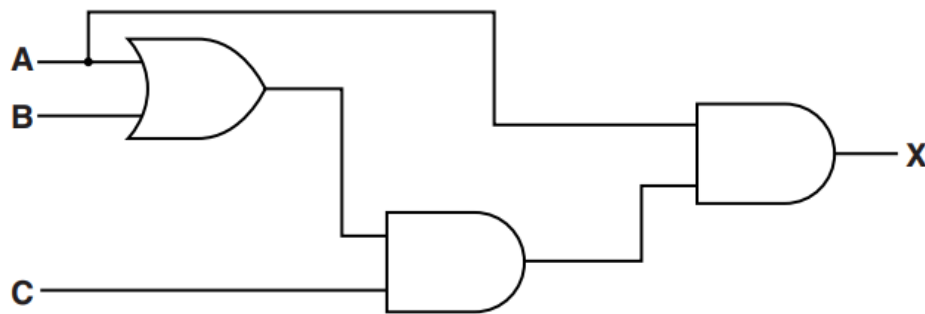
2. For the given Logic circuit:



(a) Create and fill truth table. [4]

(b) Write optimized SOP using K-Map for each output variable. [8]

3. For the given logic circuit

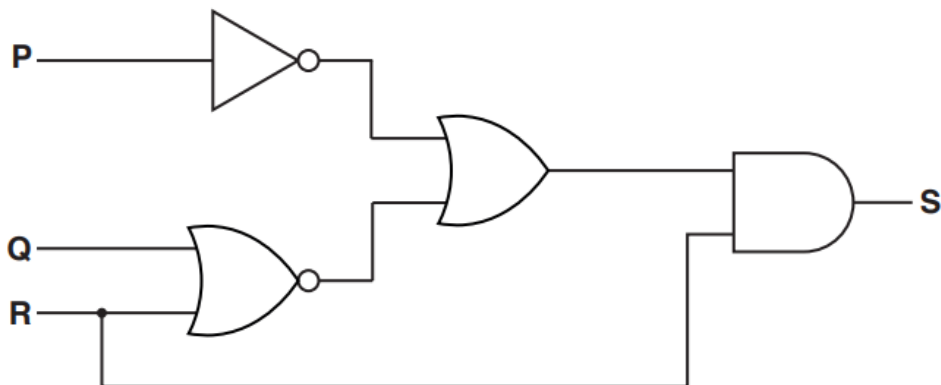


(a) Create and fill truth table. [4]

(b) Write SOP using the truth table [3]

(c) Simplify the SOP using Boolean Algebra [3]

4. For the given logic circuit



(a) Create and fill truth table. [4]

(b) Create simplified SOP using K-Map [6]

5. Simplify the following Boolean Expressions. Show your workings.

(a) $\overline{(\overline{W} + X).(Y + \overline{Z})}$ (Use De Morgan's Theorem) [4]

(b) $\overline{A}.B.\overline{C}.\overline{D} + \overline{A}.\overline{B}.\overline{C}.D + \overline{A}.\overline{B}.C.D + \overline{A}.\overline{B}.C.\overline{D} + \overline{A}.B.\overline{C}.\overline{D}$ [6]

6. Simplify the Boolean expression $\overline{A}.B.\overline{C}.\overline{D} + \overline{A}.\overline{B}.\overline{C}.D + \overline{A}.\overline{B}.C.D + \overline{A}.\overline{B}.C.\overline{D} + \overline{A}.B.\overline{C}.\overline{D}$ using K-Map. [6]

7. For $X = (A'.B + (B' + C)).C'$

(a) Draw the logic circuit. [4]

(b) Simplify the expression using K-Map. [5]