BINDURA UNIVERSITY OF SCIENCE EDUCATION
PHYSICS AND ENGINEERING DEPARTMENT
PH115: DIGITAL LOGIC EXAMINATION
DURATION: 3 HOURS

JUN 2025

Answer **ALL** questions in Section A and any **THREE** questions from Section B. Section A carries 40 marks and each question in Section B carries 20 marks.

SECTION A (Answer **ALL** the questions in this section)

1. (a) (i) Draw the electronic symbol for an AND gate. [3]

(ii) Construct a truth table for the AND gate. [5]

(b) With the aid of a truth table and a diagram, briefly explain how an OR gate can be used to design an electronic gate lock that needs two separate keys to unlock it. [10]

(c) What is the name of the gate that is often called an inverter? Explain your answer. [4]

(d) Use two switches, an LED and a dc power supply to draw a circuit diagram which behaves in exactly the same way as an OR gate. Explain your diagram. [6]

(e) Using NAND gates only, show how you can implement the EX-OR gate. Hence, draw a truth table for the EX-OR gate. [12]

SECTION B (Answer **THREE** questions from this section)

2. A logic circuit with two inputs X and Y and output Q has the following the Boolean equation:

$$Q = \left(\overline{X} + \overline{Y}\right) \bullet \left(X + Y\right)$$

(a) Copy and complete Table 2.1. [10]

Table 2.1: Truth table.

X	Y	$\overline{X}$	$\overline{Y}$	$\overline{X}+\overline{Y}$	$X+Y$	Q
0	0					
1	0					
0	1					
1	1					

(b) Complete Figure 2.1 to show how a logic circuit can be constructed from two NOT gates, two OR gates and one AND gate to represent the Boolean equation above. [9]

Figure 2.1: Part of a logic circuit.

(c) Which single logic gate has the same function as the complete circuit above? [1]

3. (a) What is a logic gate? [2]

(b) With the aid of a truth table, briefly describe how you can make a NOT gate from:

(i) a NAND gate, and [7]

(ii) a NOR gate. [7]

(c) State with an explanation, the other name for:

(i) the EX-OR gate, [2]

(ii) the EX-NOR gate. [2]

4. (a) What is a truth table? [2]

(b) Figure 4.1 shows a logic gate.

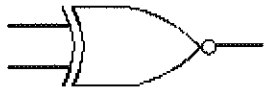

Figure 4.1: A logic gate.

(i) What name do we give to this type of gate? [1]

(ii) Construct its truth table. [9]

(iii) Explain why the logic gate shown in Figure 4.1 is referred to as the parity gate. [2]

(c) Table 4.1 shows how the input sensors A and B of an electronic system control the outputs P, Q and R.

Table 4.1: The truth table showing how the input sensors control the output.

A	B	P	Q	R
0	0	1	1	1
1	0	0	1	0
0	1	0	1	1
1	1	0	0	0

(i) Which type of logic gate will produce the P output? [2]

(ii) Which type of logic gate will produce the Q output? [2]

(iii) Write down an expression which describes the R output. [2]

5. Figure 5.1 shows a logic circuit with three inputs (i.e.), A, B and C.

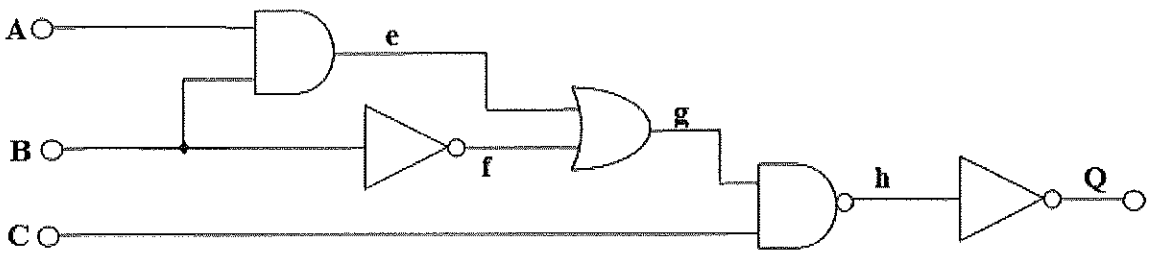

Figure 5.1: Logic gate combinations.

Construct a truth table for this logic gate network. [20]

6. The truth table for a logic circuit is shown Table 6.1.

Table 6.1: Truth table.

W	X	Y	Z	Q
0	0	1	0	0
0	1	1	1	1
1	0	1	1	1
1	1	0	1	0

(a) Inputs W and X are connected to two logic gates having outputs Y and Z. Given that Y and Z form the inputs to a third gate which provides the output Q. Complete Figure 6.1 by drawing the logic circuit that would give these outputs. [12]

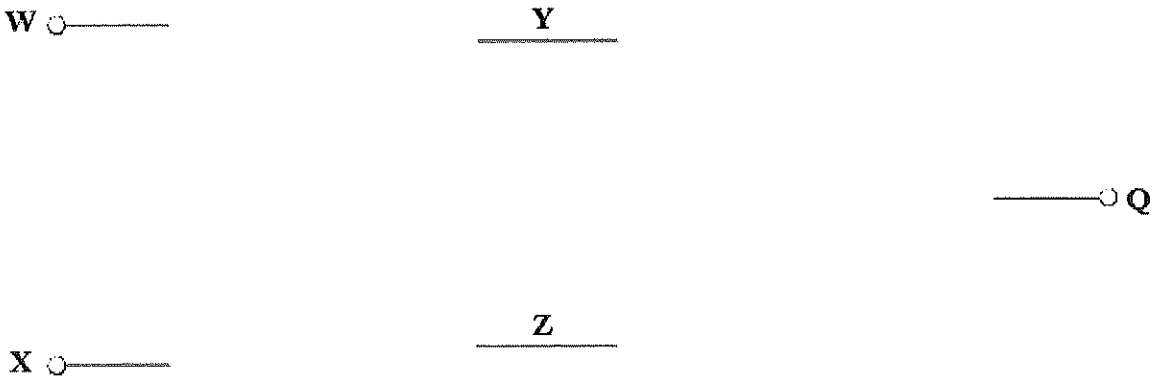

Figure 6.1: Part of a logic circuit.

(b) Use Table 6.1 to write the simplest Boolean expression for the logic signals

at Y and Z in terms of the inputs W and X. [4]

(c) Write the simplest Boolean expression for Q in terms of the inputs W and X. [3]

(d) Name a single logic gate which performs the same function as the complete circuit above. [1]

END OF PAPER