

Student's Name: ID number:

ENGR101
ENGINEERING TECHNOLOGY
Practice Test (April, 2021)

Time allowed: 70 MINUTES

CLOSED BOOK

You will be supplied with additional printed resources that you may use.
(Appendix section on pages 10-11)

Permitted materials: Non-programmable calculators are allowed.

Only printed dictionaries are allowed.

Printed foreign to English language dictionaries
are allowed.

Instructions: There are 5 questions. Attempt ALL questions.

Space for working out your solutions is provided at the end of every question.

Question	Topic	Allocated Marks	Obtained Marks	Comments
1	Number systems	12		
2	Boolean Algebra	8		
3	Logic circuit	8		
4	Karnaugh Map	8		
5	Logic circuit application	14		
	TOTAL	50		

Question 1 – Number systems

12 marks

a) Convert the decimal number 853 to binary number (2 marks).

853₁₀

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Show your calculations in the space below. Write your answer in the grid shown above, starting from the right-hand side box. Refer to part b) below.

b) Convert the binary number 0100 1010 1001 to decimal number (2 marks).

0	1	0	0
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1	0	1	0
---	---	---	---

1	0	0	1
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Show your calculations in the space below. Write your answer in the space provided above.

c) Convert the decimal number 123 to a hexadecimal number (2 marks).

123₁₀

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Show your calculations in the space below. Write your answer in the grid shown above starting from the right-hand side box.

d) Convert the following hexadecimal number to a decimal number (2 marks).

ACE₁₆ _____

Show your calculations in the space below. Write your answer in the space provided above.

e) Convert the following decimal number to an octal number (2 marks).

1193₁₀ _____

Show your calculations in the space below. Write your answer in the space provided above.

f) Convert the following octal number to a decimal number (2 marks).

263₈ _____

Show your calculations in the space below. Write your answer in the space provided above.

Question 2 – Simplifying Boolean Algebra

8 marks

Use Boolean algebra to minimize the given expression. (see Appendix on page 10)

a) $\overline{A} B \overline{C} + A B \overline{C}$

(4 marks)

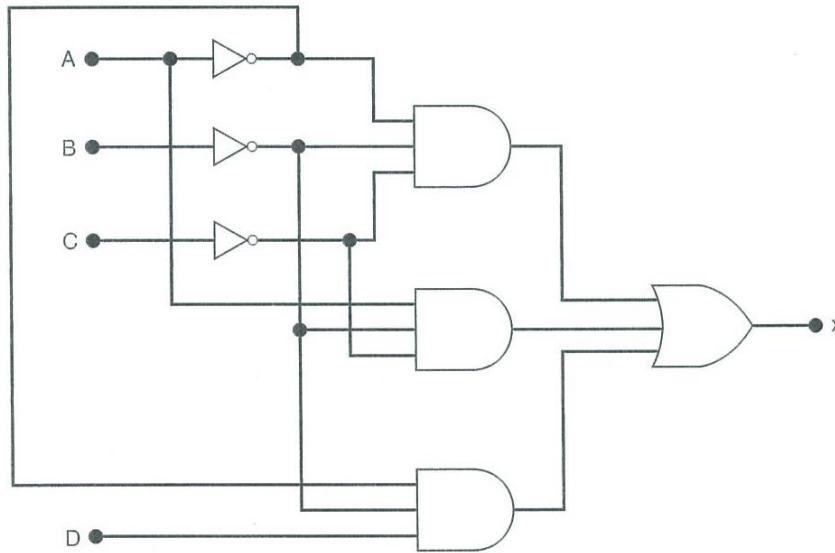
b) $(X + Y) (\overline{X} + Y) (\overline{X} + Z)$

(4 marks)

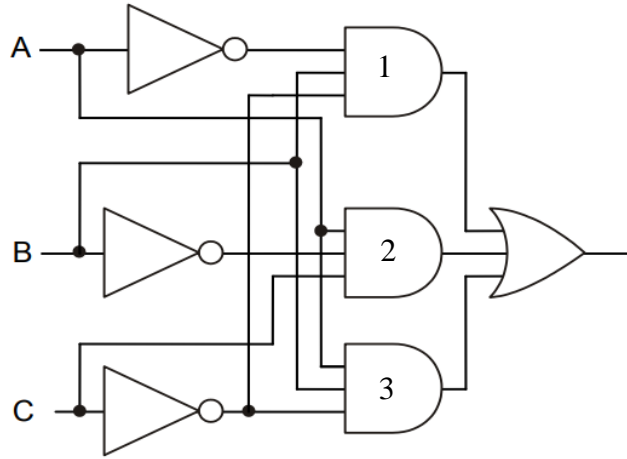
Question 3 – Electronic Circuits

8 marks

- a) Write the Boolean expression for the following logic circuit shown below.
(see Appendix on page 11 for symbols) (4 marks)



b) Show the behaviour of each AND gates (labelled 1, 2 and 3) and the OR gate in the circuit with a truth table: (4 marks)



A	B	C	AND 1	AND 2	AND 3	OR
0	0	0				
0	0	1				
0	1	0				
0	1	1				
1	0	0				
1	0	1				
1	1	0				
1	1	1				

Question 4 – Karnaugh Map

8 marks

a) Use K-Map to minimize the following Boolean expression:

$$F = \overline{A} \overline{B} + \overline{B} \overline{C} + AC + AB + BC$$

Use the table below to write your answer. Clearly mark the group of adjacent 1s.

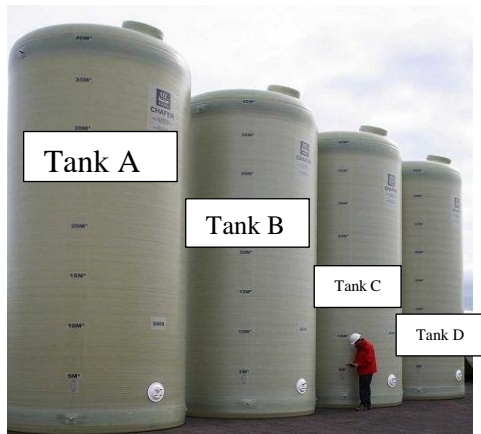
\	\overline{C}	C
$\overline{A}\overline{B}$		
$\overline{A}B$		
AB		
$A\overline{B}$		

Simplified Boolean expression:

Question 5 – Application

14 marks

- A factory has four tanks of chemicals: A, B, C and D.
- Tanks A and B have pressure sensors to indicate whether the pressure in the tank is HIGH (1) or LOW (0).
- Tanks C and D have temperature sensors to indicate whether the temperature in the tank is HOT (1) or COLD (0).



Design a logic circuit to detect when both tank A and B are HIGH and either tank C or D is COLD.

- a) Complete the following truth table to show the inputs and output for the circuit. (4 marks)

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

b) Write the SOP expression for the output. (2 marks)

c) Minimize the SOP expression by complete the K-Map shown below. (6 marks)

	$C'D'$	$C'D$	CD	CD'
$A'B'$				
$A'B$				
AB				
AB'				

d) Sketch the circuit (2 marks)

Fundamental Laws and Theorems of Boolean Algebra

- | | | | |
|-----|--|--------------------------|----------------------|
| 1. | $X + 0 = X$ | } | OR operations |
| 2. | $X + 1 = 1$ | | |
| 3. | $X + X = X$ | | |
| 4. | $X + \overline{X} = 1$ | | |
| 5. | $X \cdot 0 = 0$ | } | AND operations |
| 6. | $X \cdot 1 = X$ | | |
| 7. | $X \cdot X = X$ | | |
| 8. | $X \cdot \overline{X} = 0$ | | |
| 9. | $\overline{\overline{X}} = X$ | Double complement | |
| 10. | $X + Y = Y + X$ | } | Commutative laws |
| 11. | $XY = YX$ | | |
| 12. | $(X + Y) + Z = X + (Y + Z)$ | } | Associative laws |
| 13. | $(X \cdot Y) \cdot Z = X \cdot (Y \cdot Z)$ | | |
| 14. | $X(Y + Z) = XY + XZ$ | Distribution Law | |
| 15. | $X + Y \cdot Z = (X + Y) \cdot (X + Z)$ | Dual of Distributive Law | |
| 16. | $X + XZ = X$ | } | Laws of absorption |
| 17. | $X(X + Z) = X$ | | |
| 18. | $X + \overline{X}Y = X + Y$ | } | Identity Theorems |
| 19. | $X(\overline{X} + Y) = XY$ | | |
| 20. | $\overline{X+Y} = \overline{X} \cdot \overline{Y}$ | } | De Morgan's Theorems |
| 21. | $\overline{XY} = \overline{X} + \overline{Y}$ | | |

Standard Logic Symbols

Used in lectures

Used in text book

