

**NATIONAL UNIVERSITY OF SINGAPORE**  
**DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING**  
**ONLINE EXAMINATION**

Matriculation No.:	A0214561M
Module Code:	EE2026
Number of pages in this PDF file (including this cover page and Declaration Form): i.e. 2+no. of answer pages	2+7=9

INSTRUCTIONS TO CANDIDATES

- Follow the instructions for online examination and invigilation.
- Write your answers on A4 size paper with black or dark blue ink.
- Write the question number at the top left corner of each page. Start the answer to each question on a new page. Indicate the part, e.g. "(a)", on the left margin.
- At the end of the exam:
  - scan or take photographs of your answers (make sure your writing and/or drawings can be seen clearly);
  - enter your matriculation number, module code and the total number of pages (including the cover and declaration pages, i.e. 2+number of answer pages) on the cover page;
  - merge the completed cover page, signed declaration form and your answers into a single PDF file named **<matric\_no>-<module code>.pdf** (e.g. **A1234567R-EExxxx.pdf**);
  - open the PDF file to ensure that it has been generated without error and the contents are correct;
  - upload your PDF file into the stated LumiNUS exam submission folder within the stipulated deadline. Late submissions will not be accepted.

FOR OFFICE USE ONLY

Question	Mark	Remarks
TOTAL		

## Exam Declaration Form

Please read sections A, B and C below. Sign and submit this declaration form together with your answers.

### A. Academic, Professional and Personal Integrity

- 1. The University is committed to nurturing an environment conducive for the exchange of ideas, advancement of knowledge and intellectual development. Academic honesty and integrity are essential conditions for the pursuit and acquisition of knowledge, and the University expects each student to maintain and uphold the highest standards of integrity and academic honesty at all times.*
- 2. The University takes a strict view of cheating in any form, deceptive fabrication, plagiarism and violation of intellectual property and copyright laws. Any student who is found to have engaged in such misconduct will be subject to disciplinary action by the University.*
- 3. It is important to note that all students share the responsibility of protecting the academic standards and reputation of the University. This responsibility can extend beyond each student's own conduct, and can include reporting incidents of suspected academic dishonesty through the appropriate channels. Students who have reasonable grounds to suspect academic dishonesty should raise their concerns directly to the relevant Head of Department, Dean of Faculty, Registrar, Vice Provost or Provost.*

### B. I have read and understood the rules of the assessments stated below:

- a. Students should attempt the assessments on their own. There should be no discussion or communication, via face to face or communication devices, with any other person during the assessment.*
- b. Students should not reproduce any assessment materials, e.g. by photography, videography, screenshots, copying down of questions, etc. Posting on public forums, e.g. social media and websites, is prohibited.*

### C. I understand that by breaching any of the rules above, I would have committed offences under clause 3(I) of the NUS Statute 6, Discipline with Respect to Students, which is punishable with disciplinary action under clause 10 or clause 11 of the said statute.

- 3) Any student who is alleged to have committed or attempted to commit, or caused or attempted to cause any other person to commit any of the following offences, may be subject to disciplinary proceedings:  
(I) plagiarism, giving or receiving unauthorised assistance in academic work, or other forms of academic dishonesty.*

**I have read and will abide by the NUS Code of Student Conduct (in particular, (A) Academic, Professional and Personal Integrity), B and C when attempting this assessment.**

Signature:  Date: 6/3/2021

Matric. No.: A0214561M

1A)

A0214561 M  
Pg 1

$(4.621)_{10}$  to binary

integer part :  $(4)_{10} = (100)_2$

fractional part :  $(.621)_{10} = (.1001)_2$

$$.621 \xrightarrow{1} 1.242 \xrightarrow{0} 0.484 \xrightarrow{0} 0.968 \xrightarrow{1} 1.936$$

$$(4.621)_{10} = (100.1001)_2$$

113)

integer  $(94)_{10} = 5 \times 16^1 + 14 \times 16^0 = (5E)_{16}$

fractional  $(.318)_{10} = (.5168)_{16}$

A	10
B	11
C	12
D	13
E	14
F	15

$$.318 \xrightarrow{5} 5.084 \xrightarrow{1} 1.408 \xrightarrow{6} 6.528 \xrightarrow{8} 8.448$$

$$(5E.5168)_{16}$$

1C)

integer  $(31)_{10} = 3 \times 8^1 + 7 \times 8^0 = (37)_8$

fractional  $(.98)_{10} = (.7656)_8$

$$.98 \xrightarrow{7} 7.84 \xrightarrow{6} 6.72 \xrightarrow{5} 5.76 \xrightarrow{6} 6.08$$

$$(37.7656)_8$$

$$\begin{array}{r}
 (75.19)_{16} \\
 \swarrow \quad | \quad \searrow \\
 (00)111 \quad 0101,0001 \quad 1001(0)_2 \\
 \downarrow \quad \downarrow \quad \downarrow \quad \downarrow \quad \downarrow \quad \downarrow \\
 (1 \quad 6 \quad 5 \quad 0 \quad 6 \quad 2)_8
 \end{array}$$

$$(165.062)_8$$

$$\begin{aligned}
 1E) \quad (278.4A)_{16} &= 2 \times 16^2 + 7 \times 16^1 + 8 \times 16^0 + 4 \times 16^{-1} + 10 \times 16^{-2} \\
 &= 632.28910
 \end{aligned}$$

2A)

$$(7)_{10} = (00111)_{2's \text{ complement}}$$

$$(-14)_{10} = -(01110)_{\text{magnitude}}$$

$$= (10001)_{2's} \quad \swarrow \text{flip}$$

$$= (10010)_{2's \text{ complement}} \quad \downarrow +1$$

5 bits because  
magnitude of -14  
needs 4 bits

$$\begin{array}{r}
 00111 \\
 + 10010 \\
 \hline
 (11001)_{2's \text{ complement}}
 \end{array}$$

$$(7)_{10} + (-14)_{10} = -7$$

$$= 11001 \quad \text{(double check)}$$

2B)

$$5 \Rightarrow (a \cdot b) + (\bar{a} \cdot b) = b(a + \bar{a}) = b$$

$$6 \Rightarrow a + b$$

$$7 \Rightarrow a + \bar{a} \cdot b = a + b$$

$$8 \Rightarrow \overline{a \cdot b} = \bar{a} + \bar{b}$$

$$9 \Rightarrow \bar{a} \cdot \bar{b} = \overline{a + b}$$

$$10 \Rightarrow \bar{a} + \bar{b} = \overline{a \cdot b}$$

$$11 \Rightarrow \overline{\bar{a}} = a$$

$$1 \leftrightarrow 4$$

$$2 \leftrightarrow 9$$

$$6 \leftrightarrow 7$$

$$8 \leftrightarrow 10$$

$$3 \leftrightarrow 5$$

2C)

$$ABCD = 1011$$

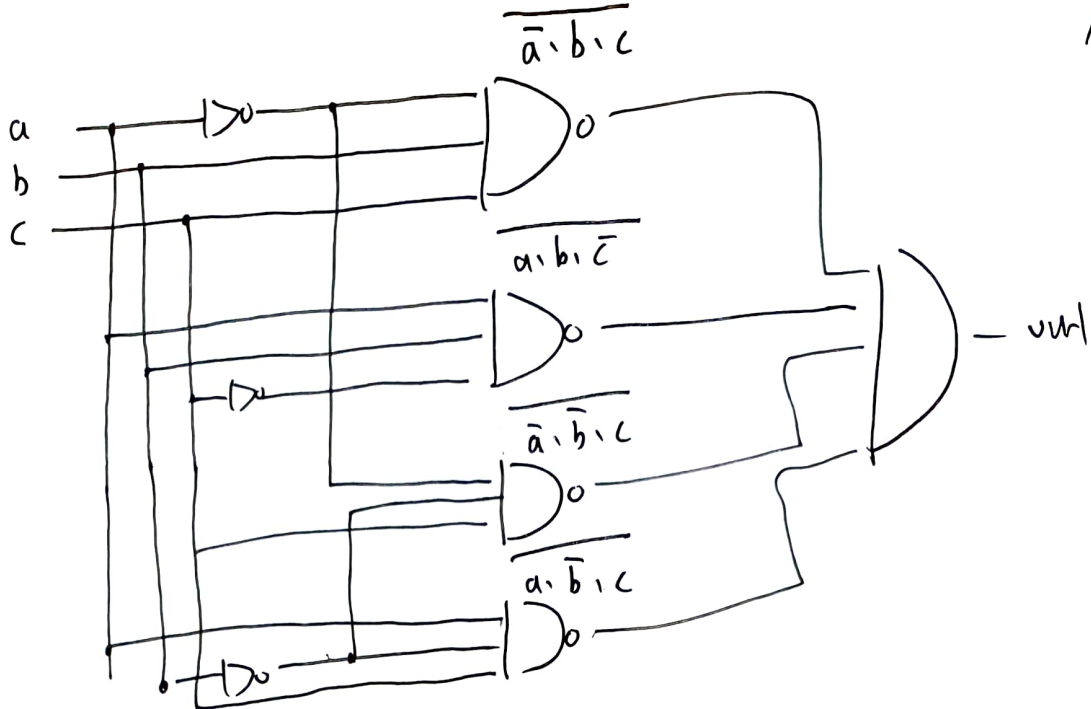
$$(A \cdot \bar{B} \cdot C \cdot D) = 1$$

2D)

$$ABCD = 0001$$

$$(A + B + C + \bar{D}) = 0$$

2E)



$$\text{out} = \overline{\bar{a} \cdot b \cdot c} \cdot \overline{a \cdot b \cdot \bar{c}} \cdot \overline{\bar{a} \cdot \bar{b} \cdot c} \cdot \overline{a \cdot \bar{b} \cdot c} \quad \text{De Morgan's}$$

$$= \overline{\bar{a} \cdot b \cdot c + a \cdot b \cdot \bar{c} + \bar{a} \cdot \bar{b} \cdot c + a \cdot \bar{b} \cdot c}$$

$$= \text{NOT} \left( \text{NOT}(a) \cdot b \cdot c + a \cdot b \cdot \text{NOT}(c) + \text{NOT}(a) \cdot \text{NOT}(b) \cdot c + a \cdot \text{NOT}(b) \cdot c \right)$$

$$2F) \quad \text{CSOP} = \overset{(1)}{\bar{A} B \bar{C}} + \overset{(2)}{\bar{A} B C} + \overset{(3)}{A \bar{B} \bar{C}} + \overset{(4)}{A \bar{B} C}$$

$$\text{out} = a \cdot \text{NOT}(b) \cdot c \overset{(4)}{+} \text{NOT}(a) \cdot b \cdot \overset{(1)}{\text{NOT}(c)} + a \cdot \text{NOT}(b) \cdot \overset{(3)}{\text{NOT}(c)} + \text{NOT}(a) \cdot b \cdot c \overset{(2)}{+}$$

$$2G) \quad \text{CPUS} = \overset{(1)}{(A+B+C)} \overset{(2)}{(A+B+\bar{C})} \overset{(3)}{(A+\bar{B}+C)} \overset{(4)}{(A+\bar{B}+\bar{C})}$$

$$\text{out} = \overset{(1)}{(a+b+c)} \overset{(2)}{(\text{NOT}(a) + b + \text{NOT}(c))} \overset{(3)}{(\text{NOT}(a) + \text{NOT}(b) + c)} \overset{(4)}{(\text{NOT}(a) + \text{NOT}(b) + \text{NOT}(c))}$$



3A)

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

$\bar{A}$  (grouping rows 00 and 01)  
 $A\bar{B}\bar{D}$  (grouping cells (11,00), (11,01), (11,10))  
 $A\bar{C}D$  (grouping cells (01,11), (10,11))

min terms

$$\text{simplified product} = \underbrace{\bar{A}}_{\text{NOT}(A)} + \underbrace{A\bar{B}\bar{D}}_{\text{a.b. NOT}(D)} + \underbrace{A\bar{C}D}_{(\text{a. NOT}(C), D)}$$

3B)

AB \ CD	00	01	11	10
00	0			0
01	0	0	0	0
11	0	0	0	0
10	0			0

max terms  
 $(\bar{B} + \bar{C})$  (grouping columns 01 and 11)  
 $(\bar{B} + C + \bar{D})$  (grouping rows 01 and 11)  
 $D$  (grouping columns 00 and 10)

$$\text{MPOS} = (D) (\bar{B} + \bar{C}) (\bar{B} + C + \bar{D})$$

$\downarrow$                        $\downarrow$                        $\downarrow$   
 $\text{NOT}(D)$                        $\text{NOT}(B) + \text{NOT}(C)$                        $\text{NOT}(B) + C + \text{NOT}(D)$

4A)

A0214861 M

Pg 6

AB \ CD	00	01	11	10
00	1	0	0	1
01	0	1	1	1
11	0	1	1	1
10	1	0	0	1

 $C\bar{D}$  $B\bar{D}$ 

4 corners

 $\bar{B}\bar{D}$ 

$$MSOP = C\bar{D} + B\bar{D} + \bar{B}\bar{D}$$

$$\begin{array}{c} | \quad | \quad | \\ C, \text{Not}(D) \quad B, \bar{D} \quad \text{Not}(B), \text{Not}(D) \end{array}$$

4B)

AB \ CD	00	01	11	10
00	0	1	0	1
01	1	0	0	1
11	0	1	1	1
10	0	1	1	1

 $(A + \bar{C} + \bar{D})$  $(B + C + D)$  $(\bar{A} + C + D)$  $(A + \bar{B} + \bar{D})$ 

$$MPOI = (A + \bar{C} + \bar{D}) (A + \bar{B} + \bar{D}) (\bar{A} + C + D) (B + C + D)$$

$$\begin{array}{cccc} a + \text{Not}(c) + \text{Not}(d) & a + \text{Not}(b) + \text{Not}(d) & \text{Not}(a) + c + d & b + c + d \end{array}$$



4c)

when should don't care condition be assigned to 1?

/   
 minimising in SOP

1	X
1	1

should include for minimising

is this considered expanding?

or creating a new grouping

→

X	X
---	---

no point  
 should all  
 include 1  $\Rightarrow$  expand