

## CITY UNIVERSITY OF HONG KONG

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Course code & title : EE1001 Fundamental of Digital Techniques

Session : Semester A 2020/21

Time allowed : 2 hours 15 minutes  
(inclusive of 15 minutes for uploading)

- This paper consists of 2 parts, PART A and PART B.
- PART A consist of 9 questions and carries 50 marks.  
PART B consist of 9 questions and carries 50 marks.
- You MUST separate (**Do NOT mix them**) “PART A answer script” with “PART B answer script”
- Write your SID and full name on each page top corner for both PART A and PART B
- Answer PART A in one set of answer script and upload “PART A answer script” onto Canvas folder “**EXAM PART A RETURN**”
- Answer PART B in another set of answer script and upload “PART B answer script” onto Canvas folder “**EXAM PART B RETURN**”
- This paper consists of SEVEN pages (including this cover page).

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### Instructions:

Please make sure you follow all instructions from the University, ARRO, and EE. Please note the following:

1. This paper consists of 2 PARTS **18** questions. The questions are ALL compulsory. Make sure that you attempt all of them. The total score is 100 marks.
2. You MUST answer and upload **PART A** and **PART B separately**.
3. This is an **open-book** exam. Students can read the lecture notes but **cannot search** materials online.
4. You are responsible for receiving the questions on Canvas, hand-write all

answers on blank answer sheets, compile or take photo of the answers into a single PDF file. Upload the files before the end of the examination.

5. Stay on ZOOM until the examiner allows you to leave.

Answering this exam paper implies your acknowledgment of the Pledge for following the Rules on Academic Honesty:

“I pledge that the answers in this examination are my own and that I will not seek or obtain an unfair advantage in producing these answers. Specifically,

1. I will not plagiarize (copy without citation) from any source;
2. I will not communicate or attempt to communicate with any other person during the examination; neither will I give or attempt to give assistance to another student taking the examination; and
3. I will use only approved devices (e.g., calculators) and/or approved device models.
4. I understand that any act of academic dishonesty can lead to disciplinary action.”

On the first page of your answer sheets, copy the following sentence and sign it: *I pledge to follow the Rules on Academic Honesty and understand that violations may lead to severe penalties.*

(Signature) \_\_\_\_\_ (Date) \_\_\_\_\_

#### Contact Information

- Should you have any technical problem during the exam, contact your course leader or invigilator via Zoom private chat,
- **Part A: email: [eetchow@cityu.edu.hk](mailto:eetchow@cityu.edu.hk) or by phone call at 34427756;**
- **Part B: email: [ee330015@cityu.edu.hk](mailto:ee330015@cityu.edu.hk) or by phone call at 34427806.**
- If you are not able to contact course leader/invigilator, you can reach the department via:
  - (a) Departmental hotline at (+852) 3442-7740
  - (b) Department Whatsapp phone: 9269-4066
  - (c) Department WeChat ID: wxid\_lly7yf5fz0j722 or scan the following QR Code



**PART A (50 marks)**

9 Questions

ANSWER ALL QUESTIONS

Upload PART A Answers to Canvas “**EXAM PART A RETURN**”

**Q1. (3 marks)**

Find the 2's complement of  $-75$  in a 8 bits representation.

**Q2. (3 marks)**

Suppose  $H = \{cat, dolphin, rangoon, mouse\}$ ,  $F = \{dolphin, cow, duck, rangoon\}$ ,  $W = \{duck, rangoon, deer, mouse\}$ . Find the items in the set  $(H \cap F)^c \cap W$ .

**Q3. (3 marks)**

$A = \left\{ \frac{p}{q} \mid p \in \mathbb{Z}, q \in \mathbb{Z}, \text{ and } q \neq 0 \right\}$ . What is  $A$ ?

**Q4. (3 marks)**

$A = \{-11, -9, -7, -5, -3, -1, 1, 3\}$ . Use set builder to describe the set  $A$ .

**Q5. (3 marks)**

This question focuses on surjective function, injective function and bijective function.

$f: X \rightarrow Y$  if  $\exists y \in Y \mid \forall x \in X \ f(x) \neq y$ . What does it mean in terms of function?

**Q6. (8 marks)**

Use contrapositive proof to prove: If  $\forall y \in \mathbb{Z}$ ,  $3y + 7$  is even, then  $y$  is odd.

**Q7. (8 marks)**

Let  $|A| = 4$ , and  $|B| = 6$ .

a. How many functions  $f: A \rightarrow B$  are there?

**(4 marks)**

b. How many of these functions are surjective?

**(4 marks)**

**Q8. (9 marks)**

- a.  $g: R \rightarrow R, g(x) = x^2$ . Determine if the function is surjective, injective, or bijective.  
(3 marks)
- b.  $f: R \rightarrow R, f(x) = 4x - 1$ . Determine if the function is surjective, injective, or bijective.  
(3 marks)
- c. The domain consists of elements of children. The co-domain consists of elements of mothers. Determine if this mapping process is injective, surjective, or bijective.  
(3 marks)

**Q9. (10 marks)**

- a. What is the 9<sup>th</sup> minimum value of the IEEE 754 32bits floating point notation?  
(6 marks)
- b. Then find its corresponding value in decimal.  
(4 marks)

**PART B (50 marks)**

**9 Questions**

**ANSWER ALL QUESTIONS**

Upload PART B Answers to Canvas “**EXAM PART B RETURN**”

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**Q1. (5 marks)**

Determine whether the statements are true or false

Q1-1. If  $A-B = \emptyset$ , which one of the followings is correct? **(1 marks)**

- (a) A.  $B=\emptyset$    B.  $B \neq \emptyset$    C.  $A \subseteq B$    D.  $B \subseteq A$

Q1-2. From a group of 7 men and 6 women, five persons are to be selected to form a committee so that at least 3 men are there on the committee. How many committees can be formed? **(2 marks)**

- (b) A. 564   B. 645   C. 735   D. 756

Q1-3. If  $A-B=A$ , then B must be  $\emptyset$ ; **(1 marks)**

Q1-4. Considering k boxes, to ensure at least two objects are in one box, k+1 objects are needed. **(1 marks)**

**Q2. (5 marks)**

Determine the following statements whether they are true or false.

Q2-1. An argument is valid if and only if all of its premises are true.

Q2-2. An invalid argument can be sound.

Q2-3. The negation of a universal statement is an existential statement.

Q2-4. Given a statement “ $p \rightarrow q$ ”, if the truth values of  $p$  and  $q$  are false, the truth value of “ $p \rightarrow q$ ” will be true.

Q2-5.  $\forall x \in R \exists y \in N, (F(x,y) \rightarrow K(x,y)) \equiv \exists y \in N \forall x \in R, (F(x,y) \rightarrow K(x,y))$

**Q3. (5 marks)**

Q3-1. Consider the predicates  $T(x,y)$  = “x sends a message to y” and  $R(x,y)$  = “x acknowledges y”. The predicate variables  $x$  and  $y$  are in the domain  $D = \{\text{devices}\}$ . Use symbolic logic to express the following statements. **(3 marks)**

- I. There are some devices which either send messages to every device or acknowledge all devices.
- II. There are at least two devices such that, if one device sends the other a message, then the receiving device acknowledges the first device (i.e., the device that sent the message).

Q3-2. Find the negation of statement I in symbolic logic and then express it in an English sentence. **(2 marks)**

**Q4. (6 marks)**

Write the first five terms of the following sequence and obtain the corresponding series:

$$a_1 = -1, \quad a_n = a_{n-1}/n, \quad n \geq 2$$

**Q5. (6 marks)**

Given  $m, n$  are positive integers,  $f(x) = (1+x)^m + (1+2x)^n$ . It is known that the coefficients of the terms  $x$  and  $x^2$  are 8 and 13 respectively. Compute:

Q5-1) The values of  $m$  and  $n$ ; **(3 marks)**

Q5-2) The coefficient of the term  $x^3$ . **(3 marks)**

**Q6. (6 marks)**

Determine how many different computer passwords are possible if:

(a) digits and letters can be repeated, and (b) digits and letters cannot be repeated.

Q6-1. 3 digits followed by 3 letters. **(3 marks)**

Q6-2. 4 digits followed by 4 letters. **(3 marks)**

**Q7. (3 marks)**

In a class, there are 8 boys and 6 girls. All girls and boys are divided into two groups with 3 girls and 4 boys in each group. Compute the possible combination.

**Q8. (5 marks)**

Without using a truth table, determine whether  $\sim(p \vee (\sim(\sim q \rightarrow (\sim q \vee r)) \rightarrow s))$  is a tautology or a contradiction. State the reason of each step.

**Q9. (9 marks)**

Design logic circuits to compute  $2 + 3$ .

Q9-1. How many adders are needed? (2 marks)

Q9-2. Which adder should be adopted? Half or full? Draw the adder circuit. (1 marks)

Q9-3. What is the input and output of each adder? (3 marks)

Q9-4. If TTL circuits are used to turn on the LED with either logic “1” output or logic “0” output, draw the TTL logic circuits with the LED cathode as the output. Why a resistor is needed? Recommend a value for the resistor. (3 marks)

**- END -**