



SUBJECT:	Computing
PAPER NUMBER:	I
DATE:	29 th May 2026
TIME:	9:00 a.m. to 12:05 p.m.

Directions to Candidates

- Answer **ALL** questions.
- Good English and orderly presentation are important.
- All answers are to be written on the booklet provided.
- The use of flowchart templates is permitted but calculators may **not** be used.

1. A digital system employs a 4-bit signed floating-point representation with 2 bits for the exponent and 2 bits for the mantissa, both in 2's complement format. The system is used to represent floating-point numbers.

- a. Convert the decimal number -2 into the 4-bit signed floating-point format. You are required to normalise the number before converting. (2)
- b. Add the two floating-point numbers $A = 1$ and $B = -0.5$, showing **all** necessary steps, including normalisation, alignment of exponents and the final result. (3)

(Total: 5 marks)

2. Boolean expressions describe the logic of digital circuits by using variables that can either be true or false, helping to simplify the design of circuits.

- a. Draw the truth table for a logic circuit with inputs A, B, C and D, where the output is determined by the Boolean expression: $(A.B) + (\overline{C}.D)$ (3)
- b. Design the logic circuit using standard AND, OR and NOT gates for the same Boolean expression. (2)

(Total: 5 marks)

3. Consider the following fragment of assembly code:

```
MOV AX, 01010001 ; Load the binary value 01010001 into register AX
SHR AX, 2        ; Shift the bits in AX 2 places to the right
```

- a. Identify the opcode and operand for the instruction `SHR AX, 2`. (1)
- b. Show the value of AX after the instruction `SHR AX, 2` is executed. (2)
- c. Explain the purpose of a cross-assembler and give **ONE** reason why it may be used. (2)

(Total: 5 marks)

Please turn the page.

4. Consider the following assembly instructions:

```

MOV AX, 25H      ; Load hexadecimal 25 into AX
MOV BX, 1000H    ; Load address 1000H into BX
MOV [BX], AX     ; Store AX at the memory address in BX
INC AX           ; Increase AX by 1
MOV CX, [BX]     ; Load into CX the value at the memory address in BX

```

a. State the addressing mode used by each of the following instructions:

i. MOV AX, 25H (1)

ii. MOV [BX], AX (1)

iii. MOV CX, [BX] (1)

b. After all the instructions are executed, what are the final values inside the registers AX and CX? Give your answers in hexadecimal. (2)

(Total: 5 marks)

5. IP addresses are a crucial part of the way the Internet functions.

a. What does the term IP stand for, and what is the main purpose of an IP address in a network? (2)

b. What distinguishes a public IP address from a private IP address? Provide **ONE** example of **each** and explain when **each** type is typically used in a network. (2)c. Explain **ONE** limitation of IPv4. (1)**(Total: 5 marks)**

6. Network security is critical to protecting systems and data from unauthorised access or attacks. Firewalls are one of the primary tools used to secure networks.

a. Explain the main function of a firewall in network security. (1)

b. Describe **TWO** types of firewalls commonly used in networking and explain how **each** type works, including their advantages and limitations. (4)**(Total: 5 marks)**

7. The System Development Life Cycle (SDLC) is a methodology used to design and build systems in a systematic and organised manner. It encompasses a series of phases that guide the development process, from initial planning to final deployment.

a. Explain the purpose of the feasibility study phase in the SDLC. What are the key aspects that should be evaluated during this phase? (2)

b. In the context of the SDLC, describe the analysis phase and explain how it contributes to the development of a successful system. (3)

(Total: 5 marks)

8. Testing is a critical part of the system development process. Various testing strategies are employed to ensure the system works as expected and meets the requirements outlined during the design phase.

- a. Define black-box testing and white-box testing, and explain the main difference between these two approaches. (3)
- b. Describe Alpha testing and Beta testing, and explain how these testing phases contribute to the overall quality assurance process before full deployment. (2)

(Total: 5 marks)

9. Different database models provide unique methods for organising and storing data. Each model has its own strengths and weaknesses, depending on the type of application.

- a. Compare the traditional relational database model with the object-oriented database model. Highlight at least **THREE** key differences between these two models. (3)
- b. Explain **ONE** major advantage of the relational model over the network model in terms of flexibility and data organisation. (2)

(Total: 5 marks)

10. In relational databases, SQL is the primary language used for retrieving, modifying and organizing data efficiently. It allows users to query, modify, and organise data in various ways to meet business and operational needs.

- a. What does the following SQL command do? Explain **each** part of the query.

```
SELECT * FROM Students
WHERE Age > 20 ORDER BY Name;
```

(2)

- b. Interpret the following SQL command:

```
SELECT Department, COUNT(EmployeeID)
FROM Employees
GROUP BY Department HAVING COUNT(EmployeeID) > 10;
```

What information does this query retrieve, and how does the HAVING clause differ from the WHERE clause? (3)

(Total: 5 marks)

11. A small electronics company is designing a new embedded control board that connects the CPU, memory chips, and several I/O devices using a shared system bus.

- a. Explain why the size (width) of the system bus is an important design consideration for the engineers and how it affects data transfer on the new board. (2)
- b. Describe the role of the system clock in the above-mentioned scenario. (1)
- c. Mention and explain **ONE** method that the electronics company may use to interface multiple devices to a common bus. (2)

(Total: 5 marks)

Please turn the page.

12. An operating system (OS) is responsible for managing the execution of processes and the resources they require.

- a. What is meant by the term deadlock in an OS? (2)
- b. Give **ONE** example of how a deadlock may occur. (1)
- c. Describe **ONE** way in which an OS may avoid or detect deadlock. (2)

(Total: 5 marks)

13. A computer system needs to schedule the following three processes which arrive at the same time:

- Process 1 (requiring 12 ms of CPU time)
- Process 2 (requiring 8 ms of CPU time)
- Process 3 (requiring 4 ms of CPU time)

Although different scheduling algorithms exist, this particular system uses Round Robin.

- a. Explain how the Round Robin scheduling algorithm works. (2)
- b. Explain **ONE** difference between Round Robin and Priority scheduling. (1)
- c. In this system, each process is given 4 ms of CPU time before the next process is run. Using Round Robin, state the order in which the processes will be executed until all processes finish. Show your working. (2)

(Total: 5 marks)

14. A computer system is designed to work with various hardware components and external devices. To manage this interaction, it makes use of interrupts.

- a. Define interrupts and explain what is meant by interrupt handling. (2)
- b. State how the CPU detects the source of an interrupt. (1)
- c. Two interrupt-handling techniques are software polling and vectored interrupts. Describe **ONE** difference between them. (2)

(Total: 5 marks)

15. A company is developing software that must run on a variety of embedded devices, each using a different CPU architecture. The team is comparing different compiler technologies to determine which one best supports their development workflow.

- a. Mention and describe **THREE** types of compilers. (3)
- b. Which of the compilers (from those mentioned in part (a)) is the most suitable for the scenario provided? Give **TWO** reasons for your answer. (2)

(Total: 5 marks)

16. The syntax of a specific programming language is represented by the grammar below:

```
<statement> ::= <variable> = <expression>
<expression> ::= <variable> | <variable> + <variable>
<variable> ::= a | b | c
```

- Define terminal and non-terminal symbols in the context of formal languages. (2)
- Identify **ONE** terminal and **ONE** non-terminal from the grammar above. (2)
- Describe the purpose of the meta-symbol | in the grammar above. (1)

(Total: 5 marks)

17. Consider the following recursive method:

```
FUNCTION multiply(a, b)
  IF b = 1 THEN
    RETURN a
  ELSE
    RETURN a + multiply(a, b - 1)
  ENDIF
END FUNCTION
```

- Perform a dry run of the call 'multiply(3, 3)' and show the recursive calls and return values for each step. (3)
- Explain why recursion is suitable for this type of problem. (1)
- State **ONE** drawback of using recursion instead of iteration for solving this problem. (1)

(Total: 5 marks)

18. This question is related to stack structures.

- What is a stack used for? (2)
- Does the stack work using the LIFO or FIFO principle? Justify your answer. (1)
- Two main operations on a stack structure are 'push' and 'pop'. Write pseudocode for both operations. (2)

(Total: 5 marks)

19. Identity Malta is planning to use a binary tree to store automatically generated record IDs in sorted order to improve search efficiency.

- Using the following record IDs, construct the corresponding binary tree:
50, 30, 70, 20, 40 (2)
- Insert the ID number 35 into the binary tree and draw the updated structure. Explain your reasoning. (2)
- Explain how the ID number 30 is deleted from the binary tree. (1)

(Total: 5 marks)

20. A development team that is familiar with object-oriented programming is reviewing other programming paradigms to determine which approaches are most suitable for their upcoming software projects.

- a. What is object-oriented programming? (1)
- b. Mention and describe the characteristics of **TWO** other programming paradigms apart from object-oriented programming. (2)
- c. For **each** paradigm identified in part (b), state **ONE** domain where it can be effectively used. (2)

(Total: 5 marks)



SUBJECT:	Computing
PAPER NUMBER:	II
DATE:	29 th May 2026
TIME:	4:00 p.m. to 7:05 p.m.

Directions to Candidates

- Answer **any FIVE** questions.
 - Good English and orderly presentation are important.
 - All answers are to be written on the booklet provided.
 - The use of flowchart templates is permitted but calculators may **not** be used.
1. An autonomous delivery robot uses digital logic to process sensor data, manage navigation and display system information. All sensor readings and internal values are stored using binary and hexadecimal representations. The robot's behaviour is controlled using Boolean logic, Karnaugh maps and combinational circuits.
- a. The robot receives binary readings from its sensors.
Convert the following binary values to decimal:
 - i. 01010110 (1)
 - ii. 11100010 (1)
 - b. The robot stores battery charge changes using 8-bit 2's complement.
Convert the value 11110100 to decimal. (1)
 - c. To adjust its speed, the robot's control processor performs an arithmetic operation by adding together the two 8-bit 2's complement values 01101001 and 10011110 in order to determine the new speed adjustment value.
Perform the binary addition and state whether overflow occurs. (2)
 - d. The robot displays diagnostic information using hexadecimal codes.
Convert the following to binary and decimal:
 - i. 9A; (1)
 - ii. C3. (1)
 - e. The robot activates a safety stop output S when an obstacle is detected ($O = 1$) or when the robot is moving ($M = 1$) and the emergency button is pressed ($E = 1$).
 - i. Write the Boolean expression for S. (1)
 - ii. Draw the truth table for the safety stop output S using the variables O, M and E. (3)
 - iii. Simplify the expression for S with a 3-variable Karnaugh map and provide the final Boolean expression. (4)
 - iv. Implement the simplified expression for S using only NAND gates. (2)
 - f. The robot uses a 7-segment display to show digits 0–9. Segment a lights up for digits 0, 2, 3, 5, 6, 7, 8 and 9.
 - i. Draw the truth table for segment a using all the binary inputs D3, D2, D1 and D0 for digits 0–9. (2)
 - ii. Write the Boolean expression for segment a (no simplification required). (1)

(Total: 20 marks)

Please turn the page.

2. A digital library system keeps track of the number of books issued to each user. The system stores the number of books in memory and updates it when a user borrows books. The following memory locations are used:

- Memory location 3000H stores the number of books currently issued to each user
- Memory location 3100H stores the number of overdue books
- Memory location 3200H stores calculated fines
- Memory location 05H stores the maximum number of books allowed

The processor is based on the 8086 architecture whilst the following assembly code fragment manages book issues:

```
MOV AX, [3000H] ; Load contents of memory location 3000H into AX
MOV BX, 02H    ; Load immediate value 02H into BX
ADD AX, BX     ; Add BX to AX
MOV [3000H], AX ; Store contents of AX in memory location 3000H
CMP AX, 05H    ; Compare AX with 05H
JLE CONTINUE   ; Jump to CONTINUE if AX is less than or equal to 05H
MOV DX, 1      ; Set DX = 1 to indicate limit exceeded
CONTINUE:      ; Continue program here
```

- a. Explain the purpose of the AX register in this program. (1)
- b. Describe the role of BX and why it is loaded with an immediate value. (1)
- c. Explain the purpose of DX in the program. (1)
- d. Explain the function of the CMP and JLE instructions. (2)
- e. If the user initially has 4 books issued and borrows 3 more, trace the values of AX and DX after **each** instruction and describe the program's behaviour. (2)
- f. The program also includes additional instructions to calculate fines for overdue books:

```
MOV AX, [3100H] ; Load contents of memory location 3100H into AX
SHL AX, 1       ; Shift AX left by 1 bit
MOV [3200H], AX ; Store contents of AX in memory location 3200H
```

- i. Identify the instruction group for **each** instruction. (2)
 - ii. If the value stored in memory location 3100H is 3, calculate the value in AX after the SHL AX instruction. (2)
 - iii. Explain what happens to AX when the instruction SHL AX, 1 is executed. (2)
- g. Suppose the instruction MOV CX, [BX+DI] is added before updating memory.
 - i. Identify the addressing mode of MOV CX, [BX+DI]. (1)
 - ii. Explain how it accesses data and its purpose in the program. (2)
 - h. Suppose that the library system needs to check multiple users' book counts stored in consecutive memory locations. The program uses CX as a counter and conditional jumps to process each user.
 - i. Explain how the CX register could be used to track the number of users. (2)
 - ii. Describe how a conditional jump instruction could be used to repeat operations for **each** user. (2)

(Total: 20 marks)

3. A large hospital is upgrading its internal network to improve patient monitoring, medical record access and communication between departments. The network supports both wired connections in administrative offices and wards and wireless connections for mobile medical devices. The hospital network also uses protocols to ensure secure access to patient data, reliable communication for telemedicine and error detection for critical data transfers.
- Explain the difference between a LAN and a WAN in the context of a hospital. (2)
 - Identify **ONE** suitable network topology for connecting multiple wards and administrative offices, and justify your choice. (2)
 - Explain the difference between serial and parallel data communication. Give **ONE** reason why serial communication is more suitable for long-distance monitoring devices. (3)
 - Define modulation and why it is important for transmitting patient data reliably. (2)
 - Compare amplitude and frequency modulation, highlighting **ONE** key difference. (1)
 - Define electro-magnetic interference (EMI) and explain how it could affect medical device data in the hospital network. (2)
 - Explain how parity and checksums detect transmission errors. (2)
 - Identify **ONE** logical and **ONE** physical measure used to secure a hospital network. (2)
 - Explain the purpose of a firewall and how it contributes to hospital network security. (2)
 - List **TWO** connectivity devices in the hospital network and explain their function. (2)

(Total: 20 marks)

4. The university wants to store information about courses, lecturers and students, and is planning to design an integrated database using a Database Management System (DBMS). The system will be used by the academic office, lecturers, and students to manage course enrolments, teaching assignments and student records.
- Identify **THREE** entities that should be part of this database. (3)
 - For **each** entity, list at least **THREE** relevant attributes. (3)
 - Suggest primary keys for **each** entity. (1)
 - Identify **TWO** relationships between the entities identified in part (a) and specify their cardinality. (2)
 - Explain why these cardinalities are appropriate for this system. (1)
 - Describe why using a relational database is preferable to using a flat file system for this course management system. (1)
 - Explain **ONE** task of a database administrator for this university system. (1)
 - Suggest **TWO** security measures to protect sensitive student and lecturer data. (2)
 - Without giving full tables, describe in words the result of the following SQL commands:
 - ```
SELECT COUNT(StudentID)
FROM Students
WHERE CourseID = 'CS101';
```

 (2)
    - ```
SELECT LecturerName, CourseID
FROM Courses
JOIN Lecturers ON Courses.LecturerID = Lecturers.LecturerID;
```

 (2)
 - Explain what a JOIN does and why it is useful in this system. (2)

(Total: 20 marks)

Please turn the page.

5. The following questions focus on computer architecture used in modern PCs based on the Von Neumann model.
- Draw the computer architecture following the Von Neumann model. Make sure to include the **FOUR** main PC components i.e. CPU, I/O Peripherals, Main Memory and System Bus. (3)
 - Briefly describe **each** of the main components included in the diagram presented for part (a). (4)
 - Identify the **THREE** main parts of the System Bus and explain the function of **each** part. (3)
 - Explain the function of the main components of the CPU. (3)

The CPU communicates with I/O peripherals using different methods of data transmission.

- Explain how I/O devices communicate with the CPU and Main Memory through **each** part of the System Bus. (3)
- Identify and describe **TWO** main types of data transmission used when communicating with I/O peripherals. (2)
- For **each** transmission type mentioned in part (f), give **ONE** example of an I/O peripheral that typically uses it. (2)

(Total: 20 marks)

6. A mid-sized company is upgrading its operating system (OS) to improve memory management performance. The current system suffers from fragmentation issues, poor handling of memory allocation, frequent page faults, and security problems where processes occasionally attempt to access restricted memory regions.
- Mention and explain **TWO** different types of fragmentation. (2)
 - For **each** type of fragmentation mentioned in part (a), provide **ONE** example of how it could occur in this company's system. (2)
 - Discuss the role of memory compaction in reducing fragmentation, and illustrate your answer with an appropriately labelled diagram. (4)

The old OS used contiguous memory partitioning, while the new OS will adopt paging.

- Explain the concept of contiguous memory partitioning. (1)
- Mention **TWO** limitations of contiguous memory partitioning that might have encouraged the company to switch to paging. (2)
- Explain the concepts of pages and page frames. (2)
- Describe **TWO** ways in which page size can influence system performance. (2)
- Although paging is an advantageous technique, it has limitations - one of which is the occurrence of page faults. Define a page fault. (1)
- Explain how the OS should respond when a page fault occurs. (2)
- Explain the purpose of memory store protection, and describe **ONE** method the OS can use to prevent a process from accessing control access to memory allocated to another process. (2)

(Total: 20 marks)

7. A company is developing a compiler for a simple arithmetic language. The syntax of the language is described using BNF, and the compiler uses parse trees to check whether expressions are valid. Once validated, expressions are translated into Reverse Polish Notation (RPN) for evaluation.

The grammar for arithmetic expressions in BNF is the following:

```
<expr> ::= <expr> + <term> | <expr> - <term> | <term>
<term> ::= <term> × <factor> | <factor>
<factor> ::= ( <expr> ) | <var>
<var> ::= A | B | C
```

- a. Explain by providing at least **TWO** reasons why a programming language requires a formal grammar such as BNF when designing a compiler. (2)
- b. Using the BNF grammar above, determine whether the following expressions are valid. Show your workings to justify your answer.
 - i. $A \times (B + C)$ (3)
 - ii. $(A - B) + C$ (3)
- c. Draw a top-down parse tree for the expression $A \times (B + C)$. (4)
- d. Convert the following into RPN:
 - i. $A \times (B + C)$ (2)
 - ii. $(A - B) + C$ (2)
- e. The company has decided to use a stack to evaluate their RPN expressions. Describe how a stack is used to evaluate RPN. (2)
- f. Evaluate the RPN expression $A \times (B + C)$ using a stack. (2)

(Total: 20 marks)

8. A software company is developing a system to manage different types of electrical appliances. A design and implementation of parts of this system in Java, making use of abstraction.
- a. Define abstraction in object-oriented programming. (1)
 - b. Apart from abstraction, identify and describe **TWO** other key concepts of object-oriented programming. (2)
 - c. For **each** concept identified in part (b), provide **ONE** example related to the scenario provided. (2)

The company wants to create a general class called 'Appliance'. Write the Java code for this class according to the instructions below:

- d. Create an abstract class named 'Appliance' which has **TWO** local variables:
 - a protected variable 'brand' of type string.
 - a private variable 'powerRating' of type double. (3)
- e. Create public getter and setter methods for both variables. (4)
- f. Include a constructor that accepts 'brand' and 'powerRating' as parameters and assigns them to the two local variables. (1)
- g. Create a public abstract method named 'calculateEnergyUsage()' that returns a double. (1)

Question continues on the next page.

The company also requires two additional classes representing types of appliances – 'WashingMachine' and 'Toaster'. Write the Java code for these subclasses using the following requirements:

- h. Both classes must extend the 'Appliance' class. (1)
- i. Both must include a constructor that calls the superclass constructor. (2)
- j. Both must implement the abstract method 'calculateEnergyUsage()' using the formulas below:
 - WashingMachine: $\text{energy} = \text{powerRating} * 2$
 - Toaster: $\text{energy} = \text{powerRating} * 0.5$ (3)

(Total: 20 marks)