

තොරතුරු හා සන්නිවේදන තාක්ෂණය Information and Communication Technology තොරතුරු හා සන්නිවේදන තාක්ෂණය Information and Communication Technology තොරතුරු හා සන්නිවේදන තාක්ෂණය Information and Communication Technology තොරතුරු හා සන්නිවේදන තාක්ෂණය Information and Communication Technology තොරතුරු හා සන්නිවේදන තාක්ෂණය Information and Communication Technology තොරතුරු හා සන්නිවේදන තාක්ෂණය Information and Communication Technology තොරතුරු හා සන්නිවේදන තාක්ෂණය Information and Communication Technology



Multiverse Victory Project - 2024

අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2024 නොවැම්බර්
 General Certificate of Education (Adv. Level) Examination, November 2024

තොරතුරු හා සන්නිවේදන තාක්ෂණය II
 Information & Communication Technology II

20 E II

Model Paper 09

පැය තුනයි
 Three hours

අමතර කියවීමේ කාලය - මිනිත්තු 10 යි
 Additional Reading Time - 10 Minutes

Use **additional reading time** to go through the question paper, select the questions and decide on the questions that you give priority in answering.

Index No:

Important :

- This paper consists of 12 pages.
- This question paper comprises of two parts, **Part A** and **Part B**. The time allotted for **both parts** is **three hours**.
- Use of calculators is **not allowed**.

Part A – Structured Essay:
 (pages 2 – 8)

- Answer all the questions **on this paper itself**. Write your answers in the space provided for each question. Note that the space provided is sufficient for your answer and that extensive answers are not expected.

Part B – Essay
 (pages 9 – 12)

- This part contains **six questions**, of which, **four** are to be answered. Use the papers for this purpose.
- At the end of the time allotted for this paper, tie the **two parts together** so that **Part A** is **on top of Part B** before handing them over to the Supervisor.
- You are permitted to remove **only Part B** of the question paper from the Examination Hall.

For Examiner’s Use Only

For the Second Paper		
Part	Question No.	Marks
A	1	
	2	
	3	
	4	
B	1	
	2	
	3	
	4	
	5	
	6	
Total		

Final Marks

In Numbers	
In Words	

Code Number

Marking Examiner 1	
Marking Examiner 2	
Marks Checked by	
Supervised by	

Part A – Structured Essay

Answer **all four** questions on this **paper itself**.

1. (a) Match each of the given phrases (i) - (viii) relating to e-commerce with the most suitable term from the list below.

List = {Paging, Real-time system, Program Counter, Kernel, Swapping, Virtual memory, Contiguous allocation, Thread, Fragmentation, Non-Preemptive, Spooling, Operating system, Overlays}

Phrases:

- i. A software program that facilitates computer hardware to communicate and operate with the computer software.
- ii. Used in the case when rigid-time requirements have been placed on the operation of a processor.
- iii. The core and most important part of a computer operating system which provides basic services for all parts of the OS.
- iv. A very useful memory management technique which enables processes to execute outside of memory.
- v. A basic unit of CPU utilization. It consists of a thread ID, program counter, register set and a stack.
- vi. A phenomenon of memory wastage. It reduces the capacity and performance because space is used inefficiently.
- vii. A process in which data is temporarily gathered to be used and executed by a device, program or the system.
- viii. Makes a process to be larger than the amount of memory allocated to it. It ensures that only important instructions and data at any given time are kept in memory.

Note: Write only the matching term against the phrase number.

- i.
- ii.
- iii.
- iv.
- v.
- vi.
- vii.
- viii.

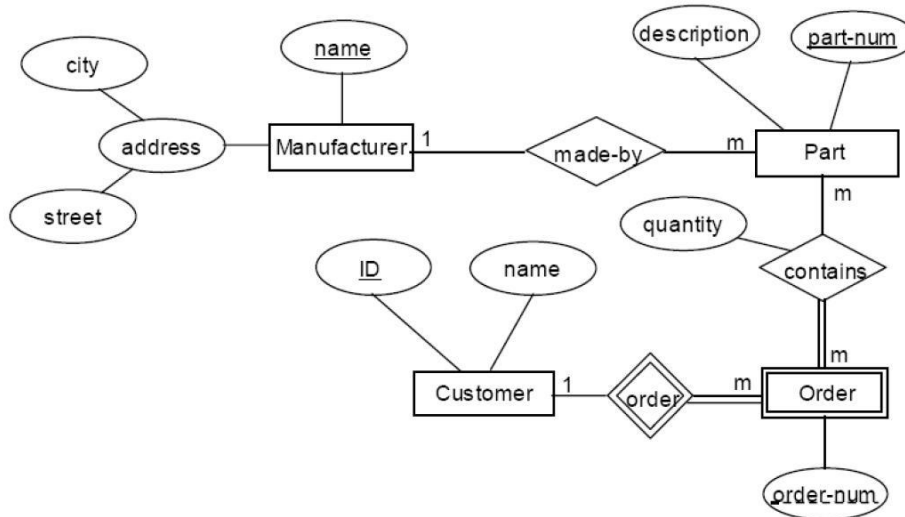
(b) Write down the two's complement representation of 28_{10} and -52_{10} using 8 bits.

(c) Write down the value of Z by taking the two's complement representation of $X+Y = Z_{16}$ using 12 bits. Assume $X=1110001010$ and $Y=1010111001$.



(d) Compute $-52_{10} + 28_{10}$ using the above representations in question (a).

2. Consider the given Entity Relationship diagram.



(a) Briefly explain why the 'address' attribute is shown using a different symbol compared to other attributes.

(b) Briefly explain why “Order” entity is shown using a different symbol compared to “Manufacturer”.

(c) The following relational tables are constructed using the ER diagram shown above. In each of the tables, the field names are missing.

Manufacturer (.....^(L).....)

Part (.....^(M).....)

Customer (.....^(N).....)

Quantity (.....^(O).....)

Order (.....^(P).....)



Identify the missing field names in each table and write them down again from L – P.

L -

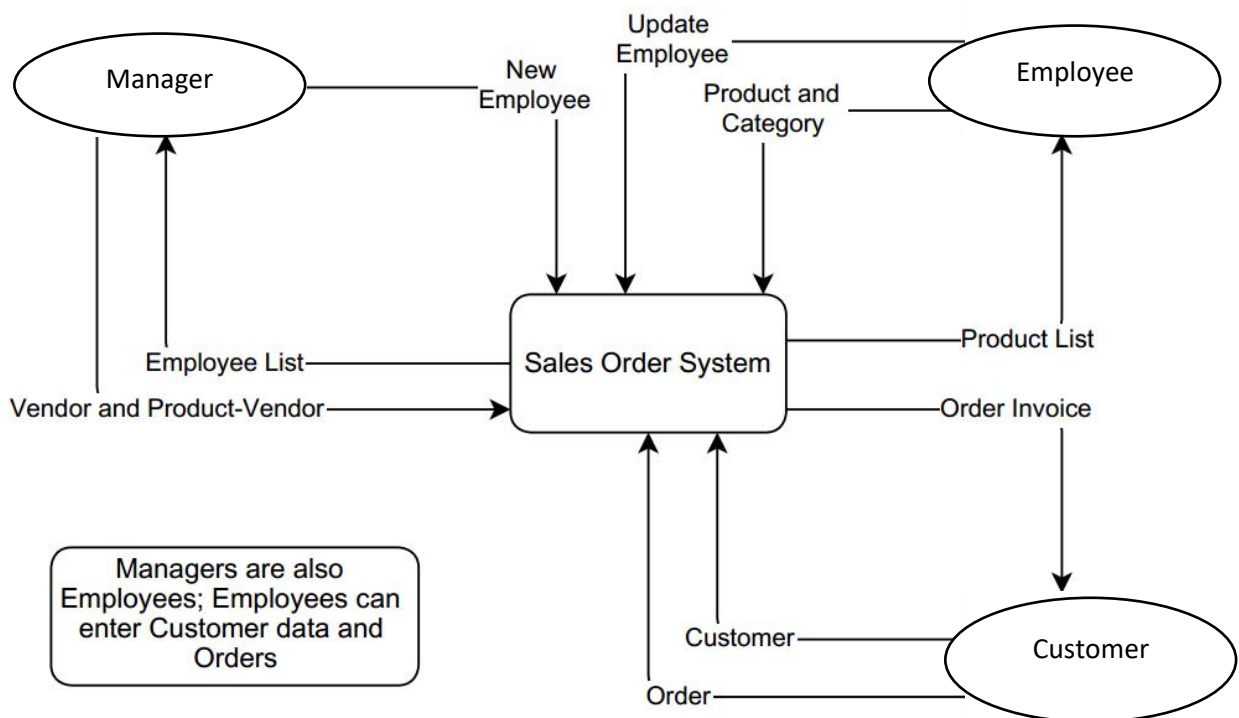
M -

N -

O -

P -

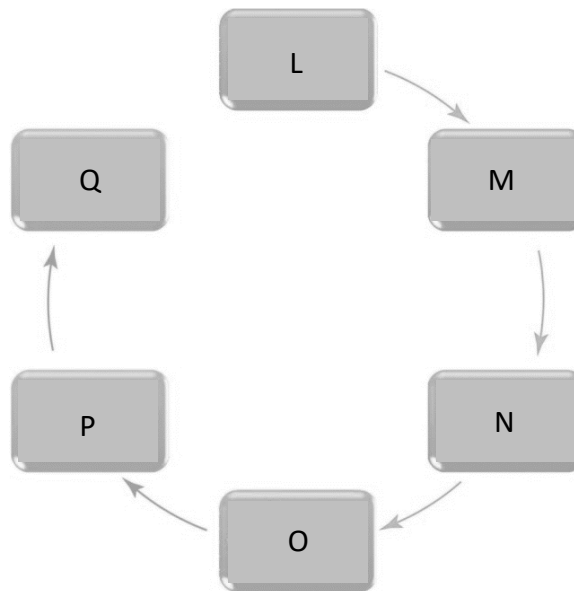
(d) Consider the following context diagram.



Write down whether each of the following statements regarding software agents is either **True or False**.

- i. The context diagram is incomplete since it does not show where the data reside and how they flow. _____
- ii. The context diagram is incomplete because it is missing the cardinalities. _____
- iii. The context diagram is at the right level of detail, such that all the stakeholders can understand it. _____
- iv. The managers, employees and customers can also be modelled using other symbols, other than boxes. _____

3. Consider the given cycle below.

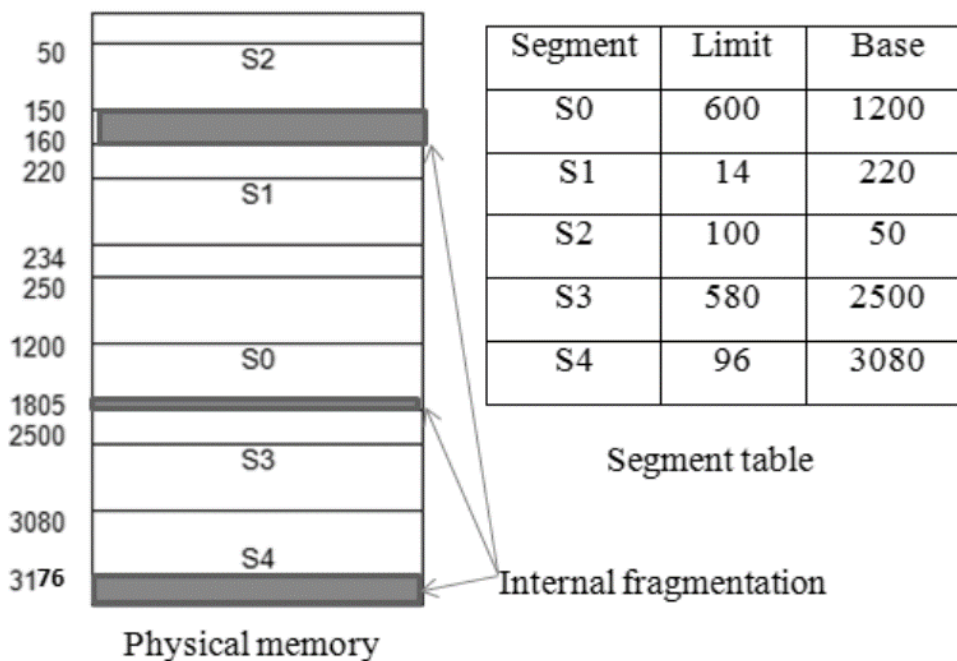


(a) Order six of the following statements in the correct sequence to describe the operations that take place when boot up a computer.

- Users Authentication
- The Operating System (OS) Loads
- System Utility Loads
- The Power-On-Self-Test (POST)
- System Configuration
- BIOS and Setup Program

(b) Consider a program consists of five segments: S0 = 600KB, S1 = 14 KB, S2= 100 KB, S3 =580 KB, and S4 = 96 KB. Assume at that time, the available free space partitions of memory are 1200–1805, 50 – 150, 220-234, and 2500-3180. Consider the **logical map** and **segment table** to answer the questions.

Logical map



i. Calculate the external fragmentation?

ii. Calculate the internal fragmentation?

4. (a) Briefly explain the difference between a port address, a logical address and a physical address.

port address –

logical address –

physical address –

(b) Explain the difference between the two packet data transfer techniques referred to as “connectionless” and “connection-orientated”.

Connectionless –

connection-orientated –

(c) Networks can be either wired using cables or wireless using radio waves.

i. Describe one benefit of using a wireless network compared to using a wired network.

ii. Describe two drawbacks of using a wireless network compared to using a wired network.

iii. Describe what is meant by a digital signature.

(d) K2 Mountain Guiding is a company that runs courses teaching people how to climb mountains. The company uses a file-based approach to store and retrieve data.

i. Describe three drawbacks of a file-based approach compared to a relational database.

Each course has a destination and a trip date, and is run by a guide. Customers can book a place on one or more courses.

The following table shows part of the stored file:

Customer name	Customer date of birth	Guide	Destination	Trip date
Jay Patel	10/10/1976	Artem	Elbrus	06/03/2023
Paul Schloss	10/04/1999	Kenton	K2	01/03/2022
Mina Wang	03/03/2000	Kenton	K2	01/03/2022
Paul Schloss	10/04/1999	Safia	Mont Blanc	07/07/2024
Jay Patel	10/10/1976	Safia	K2	04/04/2023

The company has decided to create a relational database to replace the current file-based approach.

- ii. Identify three reasons why the data in this table is not in First Normal Form (1NF).

The table, GUIDE_TABLE, is created.

Each guide has a unique guide ID.

Part of the table GUIDE_TABLE is shown:

GuideID	Guide	DateOfBirth	Gender
1	Artem	07/03/1992	M
2	Kenton	08/04/1984	M
3	Safia	10/10/1999	F

- iii. Write a Data Definition Language (DDL) statement to define the table GUIDE_TABLE.

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Information & Communication Technology II



Model Paper
09

Part B

❖ Answer any **four** questions only.

5. An alarm sounds when certain conditions occur in a nuclear reactor.

Input	Binary	Condition
P	0	carbon dioxide pressure too low
	1	carbon dioxide pressure acceptable
T	0	temperature > 300°C
	1	temperature < = 300°C
W	0	water pressure > 10 bar
	1	water pressure < = 10 bar

The output, X, of a logic circuit that drives the alarm must have a value of 1 if:

either carbon dioxide pressure too low **and** temperature < = 300°C

or water pressure > 10 bar **and** temperature > 300°C

- Draw the required logic circuit using AND, OR and NOT gates only.
- Derive the **SOP** Boolean expression for the output X using Karnaugh map.
- Derive the **POS** Boolean expression for the output X using Karnaugh map.
- Draw a logic circuit for one of simplified Boolean expressions you derived in (b) or (c) using only NAND gates.

6. Consider the following information about a university database:

- Professors have an SSN, a name, an age, a rank, and a research specialty.
- Projects have a project number, a sponsor name (e.g., NSF), a starting date, an ending date, and a budget.
- Graduate students have an SSN, a name, an age, and a degree program (e.g., M.S. or Ph.D.).
- Each project is managed by one professor (known as the project’s principal investigator).
- Each project is worked on by one or more professors (known as the project’s co-investigators).
- Professors can manage and/or work on multiple projects.



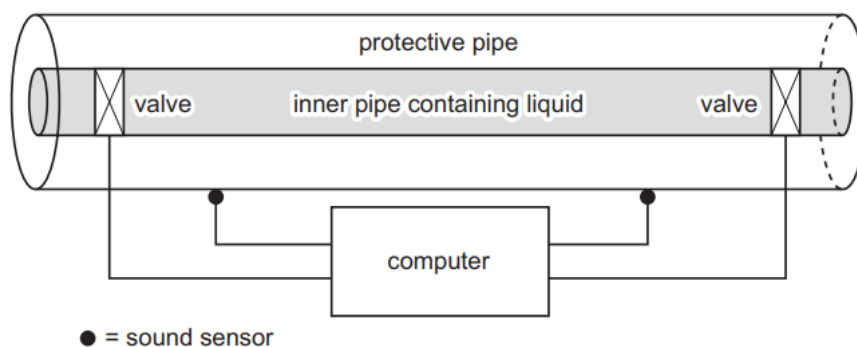
- Each project is worked on by one or more graduate students (known as the project’s research assistants).
- When graduate students work on a project, a professor must supervise their work on the project. Graduate students can work on multiple projects, in which case they will have a (potentially different) supervisor for each one.
- Departments have a department number, a department name, and a main office.
- Departments have a professor (known as the chairman) who runs the department.
- Professors work in one or more departments, and for each department that they work in, a time percentage is associated with their job.
- Graduate students have one major department in which they are working on their degree.
- Each graduate student has another, more senior graduate student (known as a student advisor) who advises him or her on what courses to take.

(a) Design and draw an ER diagram that captures the information about the university. Use only the basic ER model here, that is, entities, relationships, and attributes. Be sure to indicate any key and participation constraints.

7. (i) For each of the following five groups of hardware items, write down a computer application that would need those items. (You need to copy down the given table)

List of hardware items	Application
webcam, microphone, speakers	
barcode reader, POS terminal	
pressure sensor, ADC, lights, siren	
data gloves, data goggles	
light pen, plotter, 3D printer	

(ii) A chemical company uses pipes to transfer hazardous liquids. To protect the workforce, each pipe is inside a protective pipe.



Sensors are used to detect the sound of any liquid dripping into the protective pipe. Actuators operate the valves that regulate the flow of liquid through the inner pipe. This system is controlled by a computer.



- (a) Describe how the sensors, actuators, valves and computer are used to monitor and control the liquid in the pipe.
- (b) Give two advantages of using this computer-controlled system rather than visual checks by the workforce.

8. A user starts a video player on their single processor computer to watch tutorials. They also start a code editor to work on their programming assignment. The table below shows how the video player (P_V) and the code editor (P_C) processes run on the processor along with the operating system (P_OS) since the user started the video player.

The table below shows the processor usage over time:

Time Slot	Process Running on CPU
1	P_V
2	P_OS
3	P_V
4	P_C
5	P_V
6	P_OS
7	P_V
8	P_C

- a) What important work related to P_V and P_C will be performed by the operating system during the time period indicated by 'P_OS'?
- b) Assume that the time period the operating system allocates to each process to run on the processor in a single instance is R. Explain why Z (the time period the video player process runs at the second instance) is less than R as shown in the graph.
- c) Assume that we have a computer that can use 20-bit virtual addresses from 0 up to 1 MB. Assume further that this computer has only 64 KB of physical memory and that the page size in this computer is 8 KB. The above 20-bit virtual address is made up of the bits of the page number followed by offset bits.

User runs a particular program having a size of 64 KB on this computer. A few selected fields of the page table of that process at a particular time are shown in the table below.

Page Number	Frame Number	Present/Absent
0	010	1
1	011	1
2	000	1
3	101	1
4	---	0
5	---	0
6	100	1
7	---	0

Notes:

- The frame number is indicated in binary.
- The virtual addresses on page 0 are from 0 to 8191 and on page 1 are from 8192 to 16383, and so on.
- The Present/absent bit indicates the validity of the entry. If this bit is 1, then the entry is valid and can be used. If it is 0, then the relevant virtual page is not in physical memory.



Assume that in the above process the virtual address 0001 1000 0001 1011 is wanted. Is that page available in physical memory? If your answer is 'yes', then write down the 20-bit physical address that the above virtual address will be mapped into. If your answer is 'no', then write down the actions that the operating system will take on behalf of that process for the said requirement.

(d) Give two reasons as to why a page of a process may not be in physical memory.

(e) Explain how the operating system could find the blocks of a file when the files are stored on a hard disk using

(i) contiguous allocation, and

(ii) linked allocation.

Hint: Use the idea of the directory entry.

9. This question is based on Networking and IP address.

You are tasked by your supervisor with assigning IP addresses for your new MAN (Metropolitan Area Network), which consists of 8 different buildings, each building will have 255 workstations. Your supervisor tells you to only use as much of the 164.10.0.0 network as you need. Your supervisor will assign the IP address to the serial interfaces using a different network. You will need to determine the following four items for each of the eight buildings:

- i. Find the subnet mask required
- ii. Find the network addresses of each subnet
- iii. Find the broadcast address for each subnet
- iv. Find the host ranges on each subnet. (First usable IP address and Last usable IP address)
- v. Assume the supervisor asked you to draw a network diagram including following requirements
 - Printer for each building
 - Firewall and proxy server for the 1st subnet
 - Internet facilities
 - A DHCP server for the entire network