Part A – Structured Essay
Answer all four questions on this paper itself.

1. (a) (i) In the following HTML code, underline the parts containing errors. (Please ignore line numbering.)

```
1.    <html>
2.    <body  background-color="green">
3.    <h1>  Welcome  all  of  you  to  online  ICT  Seminar  </h1>
4.    <a  url="#one"  >A/L Student Section</a>
5.    <p> O/L ICT is not available</a>
6.    <-- Section 1 -->
7.    <h4> A/L ICT  </h4>
8.    <hr><p>Good Morning</p></hr>
9.    <br><p> This section is for students </p>
10.   </body></html>
```

[02 marks]

(ii) Write the relevant correct code lines to make "A/L Student Section" (in line number 4) a hyperlink to "A/L ICT" (in line number 7).

Code for Line 4 : ....

Code for Line 7 : ....

....

[01 mark]

(b) Consider the styles in Table 1, to answer the given questions.

Table 1

Selector	Description of the Style
Class with a class name "**art**"	Size of the font is 14px, Text should be centered
Header 1	Text color is yellow

(i) It is expected to use the above styles in several web pages on a web site. Write a suitable cascading style sheet to define the styles given in Table 1 to satisfy this requirement.

....

....

....

[01 mark]

(ii) Write the relevant HTML code lines to include the style sheet defined in part (b)(i) into a web page. [Assume that the style sheet created in part (b)(i) is saved with the name **neat**.]

....

....

....

[01 mark]

(c) An output of an HTML code rendered by a browser is shown below.

Chess Tournament

Category I

- Team A
- Team C

Category II
Team B
Team D

Registration Form

Select the team: [Team A ∨]

Your Comments: [   ]

☐ Food Required ☐ Accommodation Required

[Submit]

(i) The relevant HTML code (incomplete) is given below. Fill the blanks in it in order to get the required output.

```
<html><body>
<h2>Chess Tournament</h2>
<……………>
        <dt>Category I <……………><li>Team A</li><li>Team C</li></……………></dt>
        <dt>Category II<……………>Team B</……………><<……………>Team D</……………></dt>
</……………>
<h3>Registration Form</h3>
<form method="get">
        <………………………………>
                <label for="Team">Select the team:</label>
                <…………………… name="team">
                        <option value="a">Team A</option>
                        <option value="b">Team B</option>
                        <option value="c">Team C</option>
                        <option value="d">Team D</option>
                </……………><br><br>
                <label for="comment">Your Comments:</label>
                <………………… name="comment" rows="3" cols="30"></………………… ><br><br>
                <input type=……………………… name="food">
                <label for="fr">Food Required</label>
                <input type=……………………… name="accom">
                <label for="ar">Accommodation Required</label><br><br>
                <……………………………… type="submit" value="Submit">
        </………………………………>
</form>
</body></html>
```

[04 *marks*]

(ii) Write the relevant HTML code line to show "Team B" as the default selection for "Select the team".

………

………

[01 *mark*]

2. (a) Cloud Computing allows us to obtain computing resources and capabilities as a service. The three main types of cloud computing services are: *Infrastructure as a Service* (IaaS), *Platform as a Service* (PaaS), and *Software as a Service* (SaaS).

From those three cloud computing service types, write down the suitable service type for each of the following scenarios.

(i) To obtain an environment for application deployment and execution from a cloud service provider – ....

(ii) To obtain hard disk space for data storage from a cloud service provider – ....

(iii) To obtain data file sharing, office applications and email services from a cloud service provider – ....   **[03 marks]**

(b) Fill the blanks in the following statements with suitable words from the given list of words.

(i) .... helps to ensure the confidentiality of our data and information.

(ii) .... is the attempt to acquire sensitive information by pretending as a trustworthy entity in an electronic communication.

(iii) The illegal copying, distribution, or use of software is known as .... and .... helps us to protect our software from such illegal use.

List of words : {Encryption, Copyright, Phishing, Plagiarism, Software piracy} **[02 marks]**

(c) The following extract was taken from a software project feasibility report:

"....The software development team does not have the knowledge or prior experience of the relevant technology; the developers must be trained first and as a result of this training cost, the project will not make any profit. However it is expected that the users of the proposed product will use it willingly and no user resistance is expected..."

By considering the above extract, write either **True**, **False**, or **Cannot comment** in the blank for each of the following statements:

The proposed project has *technical feasibility*.   {..}

The proposed project has *operational feasibility*. {..}

The proposed project has *organizational (institutional) feasibility*.

{..}

[03 marks]

(d) You have decided to start an E-Business to sell your home-made food through an online store (web site). Once the customers place orders and pay through debit/credit cards, you will deliver the ordered food to their addresses.

(i) Business to Business (B2B), Business to Consumer (B2C) and Consumer to Consumer (C2C) are three E-Business transaction types. Out of these, which transaction type will occur in your E-Business?

....

[01 mark]

(ii) Incorporating a reputed software service to enable debit or credit card purchases from customers will improve customer perception and trust in your e-Commerce system. What is this software service commonly called?
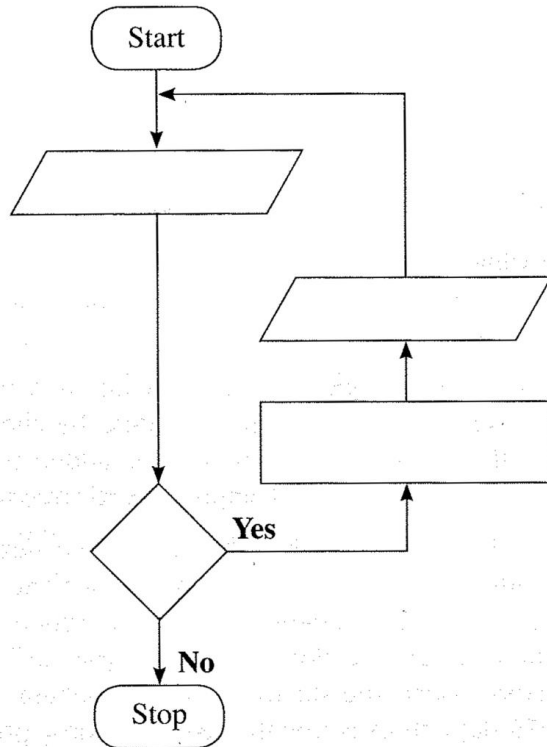
....

[01 mark]

3. (a) A flowchart is to be drawn for an algorithm to calculate and output the *areas* of triangles. The *base* and *height* of each triangle are given as inputs.

Note: Area of triangle = $\frac{1}{2}$ × base × height

The algorithm should stop when an input is less than or equal to zero.

Complete the flowchart by writing the required content for the four components left blank.

[04 marks]

(b) Complete the four (4) blanks (indicated by ......) in the following Python program to calculate the factorial of an integer.

Note: The factorial of a positive integer is defined as the product of that integer and all the integers below it. e.g., factorial of 4 is equal to 1 × 2 × 3 × 4 = 24. The factorial of 0 is defined as 1.

```
#  Get  input  from  user
...........=int(input("Enter  a  number:"))
factorial  =  1
if  num  <  0:
      print("Factorial  is  not  defined  for  negative  numbers!")

elif  ........................................  :
      print("The  factorial  of  0  is  1")
else:
      for  i  in  range(1,num  +  1):

            ...............................................
print("The  factorial  of",num,"is",........................................)
```

[04 marks]

(c) Consider the following Python program:

```
lower = 2
upper = 5

for num in range(lower, upper + 1):
    flag = 1
    if num > 1:
        for i in range(2, num):
            if (num % i) == 0:
                flag = 0
                break

        if flag == 1:
            print(num)
```

Write the output of the above program.

....

[02 marks]

4. A database application is to be developed for a hospital clinic. The design is as follows.

The registered patients in the clinic are given patient numbers and their details are stored in the PATIENTS data store. The dates and times of clinic appointments of patients are stored in the APPOINTMENTS data store.

Once a patient arrives for a clinic visit and gives the patient number, the reception officer does a **validity check** of the patient and the appointment date by checking the PATIENTS and APPOINTMENT data stores. If valid, the patient number is added to the PRESENT data store. If not, an "unregistered patient" or "invalid appointment" message is given.

When a doctor at a counter in the clinic is ready, s/he selects the next patient according to the PRESENT data store resulting in the relevant patient number and the doctor counter being shown on the display panel in the patient sitting area. When the patient comes and sits at the relevant doctor counter, the doctor retrieves patient's clinical records by accessing the PATIENTS data store. Once the doctor examines patient and prescribes any medicines for him, the PATIENTS data store is updated with the new prescription data and an entry is made to the MEDICINES data store. If needed, the doctor also schedules the next visit date/time for the patient by updating the APPOINTMENTS data store.

The pharmacist gets the prescription data from the MEDICINES data store, prepares the medicines for the patient and makes the patient number displayed on the pharmacy display panel so that the patient can pick the medicines.

(a) If a maximum of 20 patients are to be examined by the clinic doctors per an hour, write down **one** (1) functional requirement with respect to appointment scheduling.

....

....
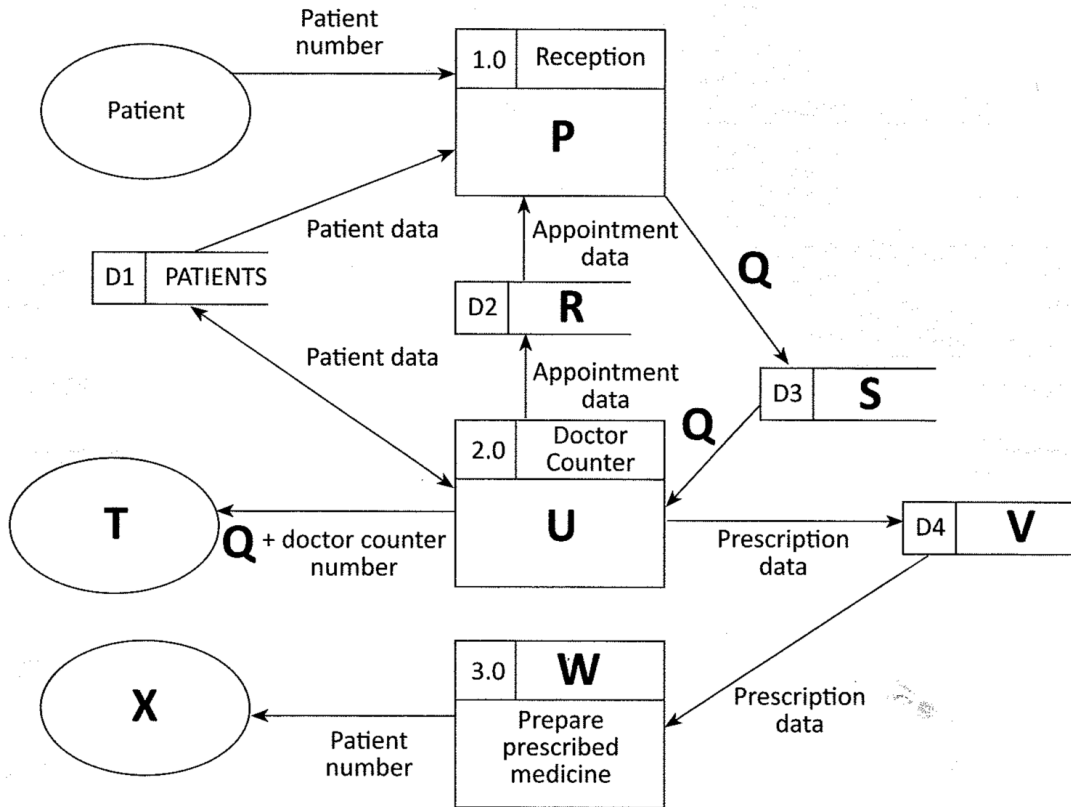
[01 mark]

(b) The hospital expects to avoid a long queue of people being formed at the clinic reception for the **validity check**. Write down **one** (1) non-functional requirement with respect to that need.

....

....

[01 mark]

(c) The following is the labeled data flow diagram for the events that take place when a patient visits the clinic to consult a doctor.

Write in the spaces provided below, the **Number** of the suitable content for each of the labels **P** to **X** choosing from the given list.

P - ......   Q - ......   R - ......   S - ......   T - ......

U - ......   V - ......   W - ......   X - ......

List

Number	Content
1	APPOINTMENTS
2	Examine patient
3	MEDICINES
4	Patient sitting area display panel
5	Pharmacy
6	Pharmacy display panel
7	PRESENT
8	Validate patient number
9	Validated patient number

[07 *marks*]

(d) Give **one** (1) difference between *white box testing* and *black box testing*.

....

....
[01 *mark*]

✳ ✳

Part B

✲ *Answer any **four** questions only.*

5. Consider the logic circuit shown in the figure, in which A, B and C are the inputs and X is the output.
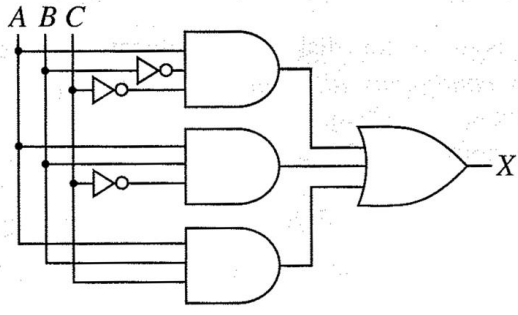
(a) Show the complete truth table for the given circuit. **[02 marks]**

(b) Complete the Karnaugh map, according to the following format.

AB

	00	01	11	10
C 0				
1				

[04 marks]

(c) Using the Karnaugh map, derive an optimal (most simplified) sum-of-products (SOP) expression for the output X. Show the loops clearly on the Karnaugh map. **[03 marks]**

(d) Using the Karnaugh map, derive an optimal (most simplified) product-of-sums (POS) expression for the output X. Show the loops clearly on the Karnaugh map. **[03 marks]**

(e) Of the optimal SOP and POS expressions you obtained in (c) and (d) above, which is better (or more suitable) to implement a simplified logic circuit? Explain your answer. **[03 marks]**

6. (a) *Parity Check* is a simple technique to detect errors in data communications.

Assume the seven bits 1010110 need to be transmitted. Explain how the odd parity check can be performed to detect any error in its transmission. **[02 marks]**

(b) The **ABC company** has two main divisions, namely **Production** and **Marketing**. Under the **Production** division, there are three units, namely **Stores, Supplies** and **Operations** having 10, 12 and 18 computers, respectively. **Marketing** division has 40 computers. ABC company has been given the 192.174.19.0/25 IP address block. All the computers of the ABC company are to be assigned IP addresses after making the subnets from this address block.

The following incomplete table shows the sub-netting. Copy it to your answer sheet and fill the empty entries.

Division/ Unit	Network ID	Broadcast ID	Subnet Mask	No. of Nodes	Usable IP Address Range
Marketing	192.174.19.0			64	
Stores		192.174.19.79		16	
Supplies	192.174.19.96			16	
Operations		192.174.19.159		32	

[06 marks]

(c) Mohan has ten (10) desktop computers and a router having 2 ports with a 64 Mbps Internet connection. Each computer has an adequate number of network interface cards. He also has a sufficient number of RJ 45 connected twisted pair cables.

Mohan wants to start an Internet Browsing Center with the above equipment and seeks your advice for it. He informs you that he is not in a position to invest money for any new equipment.

   (i) Which network topology will you suggest for Mohan? **[01 mark]**

   (ii) Draw the logical arrangement of the network that you propose. **[02 marks]**

(iii) Mohan would like to improve the connection speed to the clients while saving the existing bandwidth of the Internet connection. Further he needs to have the control of the Internet access while ensuring the privacy of the client. What is the technical suggestion you would give for this? **[01 mark]**

(iv) There is a need to protect this private network by filtering the communication traffic and blocking outsiders from gaining unauthorized access. What mechanism will you suggest to achieve this? **[01 mark]**

(v) Include the solutions that you proposed for (iii) and (iv) above in the logical network arrangement that you drew for (ii). **[02 marks]**

7. (a) **PQR Books**, a book shop in your area starts an E-Commerce site to expand its business and to provide services to the customers in other areas. Through it the customers can select their desired books and stationery products and confirm their orders online.

   (i) What is the E-Commerce business type applicable in this scenario? **[01 mark]**

   (ii) What is the revenue model used in this E-Commerce site of PQR Books? **[01 mark]**

   (iii) With the successful implementation of its E-Commerce site, PQR Books decides to offer digital learning material such as e-books and audio-visual content to its customers. Do you recommend the same revenue model of (ii) above for this as well? Justify your answer. **[01 mark]**

   (iv) For an increased customer base and popularity, PQR Books plans to provide free access to these digital content through its streaming channel.
Suggest a strategy to increase its business revenue with the help of this proposed streaming channel. **[01 mark]**

   (v) Write down a key challenge this bookshop has to face when implementing this digital content channel proposed in (iv) above. **[01 mark]**

   (vi) Name a suitable expansion solution for this E-Commerce site to incorporate both related (e.g., books, stationery etc.) and unrelated (e.g., grocery items, etc.) products or services to enable a more competitive purchasing experience to its customers. **[01 mark]**

(b) The following description is about **myShopper**, a multi-agent system which enables a buyer to search the entire online marketplace for the best products. In addition to the price, reviews by other buyers, special offers, reputations of the merchants and the lengths and types of warranties are also considered.

When a **user** (buyer) accesses the **myShopper** website, a **chat-bot** agent starts interacting with the user. User can use voice or text as the input medium to give his/her requirements for a product. During the interaction, the **chat-bot** passes the extracted information to a **search-agent** who will takeover the search for the best product for the user. For this, the **search-agent** will start several **domain-agents** specifying each of them the requirements of the user and specific domains (web sites) to search in. To speedup the search, each **domain-agent** will start several **sub-agents** to search sub-domains under its main domain. After the search, each **sub-agent** will pass the appropriate results back to its parent **domain-agent**. Once all such results from the sub-agents are received, each **domain-agent** compares them and submits the best results to the **search-agent**. The **search-agent** will then compare all such results and gives the details of the best product back to the **chat-bot**. The **chat-bot** will then display it to the **user** as text.

   (i) Draw a simplified agent diagram for the above multi-agent system. Name all the entities in your diagram and clearly indicate the interactions between them. **[06 marks]**
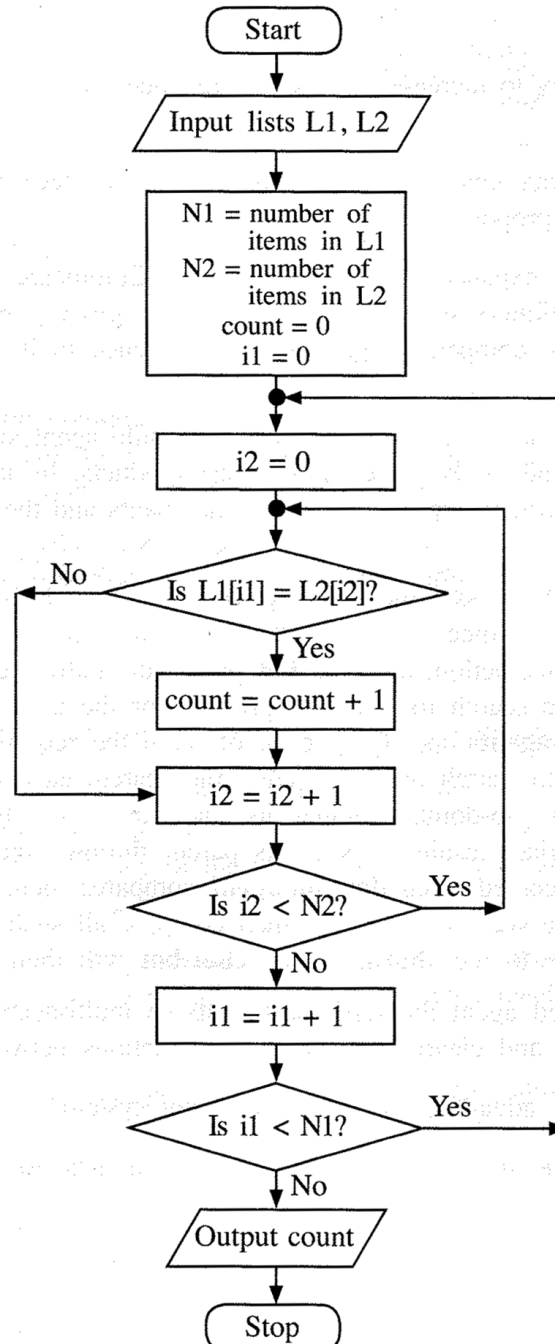
   (ii) Write **one** major advantage of this multi-agent system. **[01 mark]**

   (iii) Write down **one** ICT related challenge which has to be faced when developing a **sub-agent**. **[02 marks]**

8. (a) Suppose the ages (in years) of **n** (**n** > 1) students in a school are in a list **L**. Assuming the list **L** and an integer **k** are inputs, express an algorithm using **either** a flowchart **or** pseudo-code to compute and output the average age of students in **L** whose age is less than **k** years.

[05 marks]

(b) Consider the algorithm expressed by the flowchart. L1 and L2 are non-empty lists of integers. Each of L1 and L2 has unique elements (no duplicates). But there can be elements that are in both L1 and L2. The notation L[x] denotes the element at Index x of a list L. If there are N elements in list L, then the indices are from 0, 1, 2, ... to (N-1).

```
                    ┌─────────┐
                    │  Start  │
                    └────┬────┘
                         ▼
              ╱──────────────────────╱
             ╱   Input lists L1, L2  ╱
            ╱──────────────────────╱
                         ▼
            ┌────────────────────────┐
            │ N1 = number of         │
            │       items in L1      │
            │ N2 = number of         │
            │       items in L2      │
            │ count = 0              │
            │ i1 = 0                 │
            └───────────┬────────────┘
                        ▼
            ┌────────────────────────┐
            │        i2 = 0          │
            └───────────┬────────────┘
                        ▼
  No             ◇─────────────────◇
 ◄───────────────  Is L1[i1] = L2[i2]?
  │                ◇─────────────────◇
  │                        │ Yes
  │                        ▼
  │             ┌────────────────────┐
  │             │  count = count + 1 │
  │             └──────────┬─────────┘
  │                        ▼
  │             ┌────────────────────┐
  └────────────►│     i2 = i2 + 1    │
                └──────────┬─────────┘
                           ▼
                   ◇───────────────◇   Yes
                     Is i2 < N2?    ├──────►
                   ◇───────────────◇
                           │ No
                           ▼
                ┌────────────────────┐
                │     i1 = i1 + 1    │
                └──────────┬─────────┘
                           ▼
                   ◇───────────────◇   Yes
                     Is i1 < N1?    ├──────►
                   ◇───────────────◇
                           │ No
                           ▼
                ╱────────────────────╱
               ╱    Output count    ╱
              ╱────────────────────╱
                           ▼
                    ┌─────────┐
                    │   Stop  │
                    └─────────┘
```

(i) What would be the output if L1= 2, 4, 7, 9, 3, 5 and L2 = 1, 3, 8, 9, 6, 5, 7?

[02 marks]

(ii) What is the purpose of this algorithm?

[02 marks]

(iii) Develop a Python program to implement the algorithm expressed by the flowchart.

[06 marks]

9. (a) A **virtual** supermarket has registered suppliers to supply the customer orders placed online. The supermarket always fulfils its customer orders through these suppliers. One supplier is responsible only for the customers who live in the supplier's area. A customer has only one supplier. Each supplier is characterized by a code (unique), address and contact numbers. A supplier can have several contact numbers.

Each customer is characterized by an email address (unique), name and location.

A customer can confirm orders. Each order has only one supplier and one customer.

An order is characterized by an order number (unique), description and a value. A supplier can supply more than one order.

Note: Use only the terms from the list given below for your ER diagrams of parts (i) and (ii).

List: {address, agent, code, confirms, contactNo, customer, description, email, hires, location, name, order, orderNo, supplier, supplies, value}

(i) Draw the Entity Relationship (ER) diagram for the above description.   **[07 marks]**

(ii) Sometimes suppliers hire agents to support the order supplies. However, the supermarket identifies the agents only through registered supplier codes. An agent is characterized by a name and a contact number. Each agent is working only for one supplier and a supplier is also getting only one agent's service.

Add these details to the ER diagram you drew for part (i).   **[04 marks]**

(b) A building construction company signs contracts with its clients. Each contract is handled by an agent of the company.

The **Contracts** table contains the details of the contracts. It has contract number, agent's code, name and mobile phone number represented with **CNo, ACode, AName** and **AMobile** attributes respectively. The client's name is represented with **Client**. Primary key of the **Contracts** table is **CNo**.

Contracts

CNo	ACode	AName	AMobile	Client
C-112	EP003	Anura	0714545866	Srimal
C-103	EP006	Navod	0774511320	Abish
C-116	EP003	Anura	0714545866	Nehara
C-224	EP015	Virah	0763538147	Srimal

(i) Write an SQL statement to change in the **Contracts** table, the mobile number of the agent whose agent code is EP003 to 0772222222.   **[01 mark]**

(ii) In which normal form does the **Contracts** table exist?   **[01 mark]**

(iii) Convert the **Contracts** table into next normal form. (It is **not** necessary to write the data in derived relations in the next normal form.)   **[02 marks]**

10. (a) (i) Explain **one (1)** way in which the *bar code technology* can be beneficial to a library management system. **[02 marks]**

(ii) Most modern computers have multiple processors in them. Explain **one (1)** way in which the multiple processors in such computers can be beneficial. **[02 marks]**

(iii) Explain what is meant by *volatile memory* **and** write down **one (1)** example for such selecting from the list below.

List: {Dynamic RAM (DRAM), Hard disk, L1 cache, Registers} **[02 marks]**

(b) (i) A student asks you how all applications started by him execute simultaneously although he has a **single-processor computer**. Write down your explanation. **[03 marks]**

(ii) Programs whose sizes are even larger than the size of the available physical memory of a computer could be executed on it. How can that be possible? **[04 marks]**

(iii) When *linked allocation* is used for disk space allocation, each file needs slightly more storage space than when *contiguous allocation* is used. Explain the reason for it.

[02 marks]

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