

සියලුම හිමිකම් ඇවිරිණි / முழுப் பதிவுரிமையுடையது / All Rights Reserved

ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව  
 Department of Examinations, Sri Lanka

අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2023 (2024)  
 கல்வியியல் பொதுத் தராதரப் பத்திர (உயர் தரப் பரீட்சை, 2023 (2024)  
 General Certificate of Education (Adv. Level) Examination, 2023 (2024)

මහා විද්‍යාල හා සන්නිවේදන තාක්ෂණය II  
 தகவல், தொடர்பு, தொழில்நுட்பவியல் II  
 Information & Communication Technology II

20 E II

පැය තුනයි  
 மூன்று மணித்தியாலம்  
 Three hours

අමතර පිටවීමේ කාලය - මිනිත්තු 10 යි  
 மேலதிக வாசிப்பு நேரம் - 10 நிமிடங்கள்  
 Additional Reading Time - 10 minutes

Use additional reading time to go through the question paper, select the questions you will answer and decide which of them you will prioritise.

Index No. : .....

**Important:**

- \* This question paper consists of 13 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 - 7)

- \* 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 answers and that extensive answers are not expected.

**PART B – Essay:**  
 (pages 8 - 13)

- \* This part contains six questions, of which, four are to be answered. Use the papers supplied 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 Examiners' Use Only**

For the Second Paper		
Part	Question No.	Marks
A	1	
	2	
	3	
	4	
B	5	
	6	
	7	
	8	
	9	
	10	
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.*

Do not  
write  
in this  
column

1. (a) Draw the expected output of the following HTML code segment when rendered by a web browser.

```
<html>
<body>
<ul style="list-style-type:none;">
  <li>Cricket</li>
  <li>Football</li>
  <li>Hockey</li>
</ul>
</html>
</body>
```

Note: Consider the following dotted line box as the display area of the browser.

- (b) A registration form for a speech competition and its labeled HTML source are given in Figures 1.1 and 1.2 respectively.

**Back to the nature!**

**Speech Competition**

**Registration form**

Name:

Gender:  Male  Female

District:

Email:

Subscribe for newsletter?


**Western Province Environment**

Figure 1.1

Do not write in this column

```

<html>
<A>Back to the nature!</A>
<B>Speech Competition</B>
<h3>Registration form</h3>

<form method="C" D="./action_page.php">
  <label for="name">Name:</label>
  <input type="E" name="name"><br><br>

  <label for="gender">Gender:</label>
  <input type="F" name="gender" id="male" value="male">
  <label for="male">Male</label>
  <input type="F" name="gender" id="female" value="female">
  <label for="female">Female</label> <br><br>

  <label for="G">District: </label>
  <H name="district" id="district">
    <option value="colombo">Colombo</option>
    <option value="gampaha">Gampaha</option>
    <option value="kalutara">Kalutara</option>
  </H><br><br>
  <label for="email">Email:</label>
  <input type="email" name="email"><br><br>

  <input type="I" name="newsletter" id="newsletter">
  <label for="newsletter">Subscribe for newsletter?</label><br><br>

  <input type="J" value="Submit">
</form>
<br>
<K="wpeLogo.jpg" alt="L" width="50" height="60">
<M="https://www.wpe.lk" title="N">Western Province Environment</a>
</html>

```

Figure 1.2

For each of the labels A to N in the HTML code in Figure 1.2, choose a suitable replacement from the given list. In the answer table, write down the number of the replacement for each label.

List:

1: action	2: a href	3: caption	4: checkbox	5: district
6: font	7: h1	8: h2	9: h3	10: head
11: img src	12: More details	13: name	14: post	15: radio
16: select	17: submit	18: text	19: th	20: WPE logo

Answer table:

A :	B :	C :	D :	E :	F :	G :
H :	I :	J :	K :	L :	M :	N :

(c) The action\_page.php file mentioned in the given code of Figure 1.2 is shown below.

Do not write in this column

```
<?php
$servername = "localhost"; $username = "root"; $password = "";
$dbname = "environment";
// Create a connection
$conn = new mysqli($servername, $username, $password, $dbname);

// Section P
$name = $_POST['name']; $gender = $_POST['gender']; $district = $_POST['district']; $email = $_POST['email']; $newsletter = $_POST['newsletter'];
// section P end
// Section Q
$sql = "INSERT INTO applicants (name, gender, district, email, newsletter) VALUES ('$name', '$gender', '$district', '$email', '$newsletter')";
// section Q end

if ($conn->query($sql) === TRUE) {
    echo "Data inserted successfully!";
} else {
    echo "Error: " . $sql . "<br>" . $conn->error;
}

// Close the connection
mysqli_close($conn);
?>
```

Write down the purpose of section P and the purpose of section Q.

P : .....  
 Q : .....

2. (a) A simple and high-level view of the data lifecycle consists of three steps. Write the 2<sup>nd</sup> and the 3<sup>rd</sup> steps of the data life cycle.

- 1<sup>st</sup> step is the creation of data
- 2<sup>nd</sup> step is .....
- 3<sup>rd</sup> step is .....

(b) (i) Modern Artificial Intelligence relies on large amounts of data, which are often managed with cloud-based storage solutions. What is the cloud computing service model used here?

.....

(ii) Quantum computers, although seen as a promising type of computing machines for the future, are still expensive to own, operate and maintain. Suggest a technical approach to make the computing power of the quantum computers accessible to the public users as per their needs, at an affordable price.

.....  
 .....

(c) For the box in each of the following statements, select a suitable replacement from the given list and write the number of the selected replacement in the box.

- List : {1 - B2B, 2 - C2B, 3 - G2C, 4 - a payment gateway, 5 - a reverse auction, 6 - a virtual storefront, 7 - a web portal, 8 - an online auction, 9 - an online marketplace}

Do not write in this column

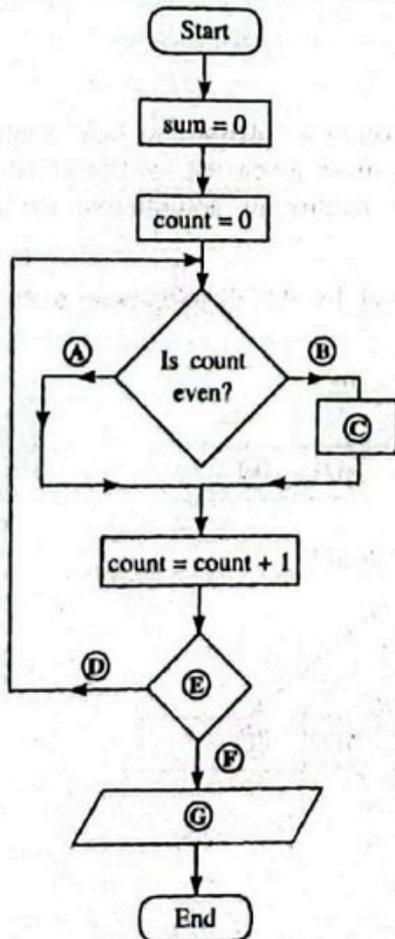
- (i) A web-based platform that provides a single point of access to a range of information from different sources, is known as .
  - (ii) When one requests to renew his/her vehicle revenue license and pays online for it through the official website, he/she is performing an e-commerce transaction of  type.
  - (iii) The ABC e-commerce company does not allow buyers to explore competitor products from other sellers within its website. ABC website operates as .
  - (iv) In  buyers bid for the prices at which they are willing to buy a given product or service.
  - (v) An online shopping website is suitable to be connected to .
- (d) (i) Your friend thinks the digital divide is a tool used for arithmetic division. Briefly explain to your friend what the digital divide is.

.....  
 .....  
 .....

- (ii) E-waste is becoming a major environmental problem in Sri Lanka. Suggest a step that we can take to reduce the environmental impact of our e-waste.

.....  
 .....  
 .....

3. (a) Write down the most suitable replacements for labels A to G in the following flowchart which is drawn to calculate and display the sum of first ten even numbers.



- A : .....
- B : .....
- C : .....
- D : .....
- E : .....
- F : .....
- G : .....

Do not write in this column

(b) (i) What is the output of the following Python code?

```
def func(n):
    MyNumber=[]
    for i in range(4,n+1):
        if i%2==0:
            MyNumber.append(i)
    print(MyNumber)
func(30)
```

(ii) Write down the output in the above Python code when the condition `if i%2==0:` is changed to `if i%2 != 0:`

(c) Write down the replacements for the labels of the following Python code which has been written to find the largest of a set of integers.

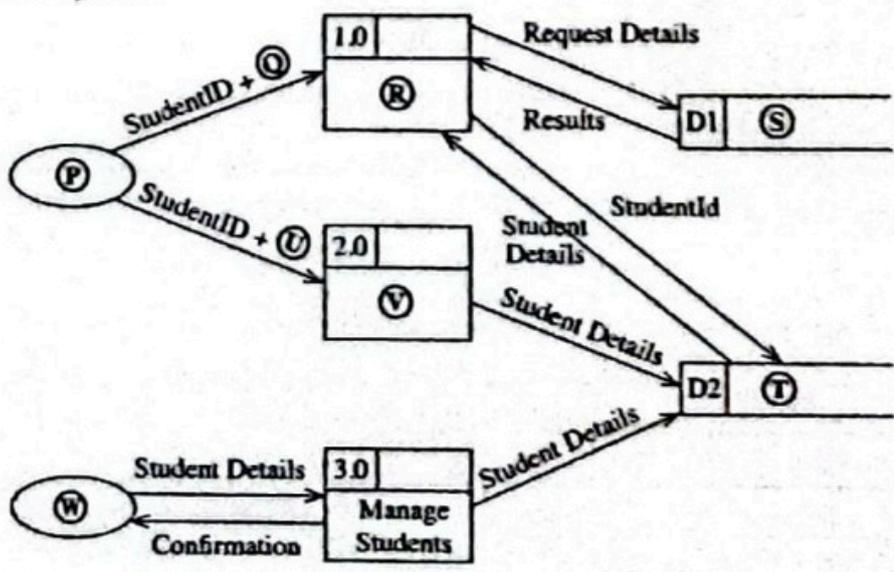
```
def findlargest(myList):
    largest = (A)
    for i in (B):
        if i > (C)
            largest = (D)
    print("largest value is", (E))

list1=[4,6,24,12,8,94,22]
findlargest((F))
```

- (A) - .....
- (B) - .....
- (C) - .....
- (D) - .....
- (E) - .....
- (F) - .....

4. A team in the school IT society has been requested to develop a software to help students reserve computers in the school laboratory. The students are to be given the facility to update their information. The administrator should be given the facility to add/remove students to/from the system.

(a) The following is the data flow diagram (DFD) prepared by the development team for the above system.



A numbered list of replacements for the labels (P) to (W) are given below. Write down in the relevant box the number of the most suitable replacement for each of the labels given in the DFD.

Do not write in this column

List: {1 - Administrator, 2 - Handle request, 3 - Reservations, 4 - Request details, 5 - Student, 6 - Students, 7 - Student details, 8 - Update student details}

(P) -  (Q) -  (R) -  (S) -   
 (T) -  (U) -  (V) -  (W) -

- (b) The computers are to be made available for students only for 30-minute slots between 8 am - 5 pm on weekends. However a student is allowed to reserve only a maximum of two 30-minute slots per weekend.

Write down one functional requirement with respect to computer reservations.

.....  
 .....

- (c) Give one technical aspect that the development team should check when conducting the technical feasibility study of this project.

.....  
 .....

- (d) The *waterfall model* is suggested for the above development. Why is a proper requirement analysis critical in this project to ensure its timely completion?

.....  
 .....

- (e) Three students are to develop the *reservation*, *update student details* and *manage students* modules separately. The IT teacher had taught different types of software testing. What is meant by "integration testing" in this system?

.....  
 .....

- (f) The IT teacher suggests the team doing a *direct deployment* of this software. Give one reason as to why the teacher did not suggest a *parallel deployment*.

.....  
 .....

- (g) One member of the IT society wants a COTS (Commercial-Off-The-Shelf) software to be considered for this system instead of developing it. Give one reason as to why the team should reject it.

.....  
 .....

\*\*

ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව  
 இலங்கைப் பரீட்சைத் திணைக்களம் இலங்கைப் பரීட்சைத் திணைக்களம் இலங்கைப் பரීட்சைத் திணைக்களம் இலங்கைப் பரීட்சைத் திணைக்களம் இலங்கைப் பரීட்சைத் திணைக்களம்  
 Department of Examinations, Sri Lanka Department of Examinations, Sri Lanka Department of Examinations, Sri Lanka Department of Examinations, Sri Lanka Department of Examinations, Sri Lanka  
 இலங்கைப் பரීட்சைத் திணைக்களம் இலங்கைப் பரීட்சைத் திணைக்களம் இலங்கைப் பரීட்சைத் திணைக்களம் இலங்கைப் பரīட்சைத் திணைக்களம் இலங்கைப் பரīட்சைத் திணைக்களம்  
 Department of Examinations, Sri Lanka

අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2023 (2024)  
 கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2023 (2024)  
 General Certificate of Education (Adv. Level) Examination, 2023 (2024)

කොරකුරු හා සන්නිවේදන තාක්ෂණය II  
 தகவல், தொடர்பாடல் தொழினுட்பவியல் II  
 Information & Communication Technology II

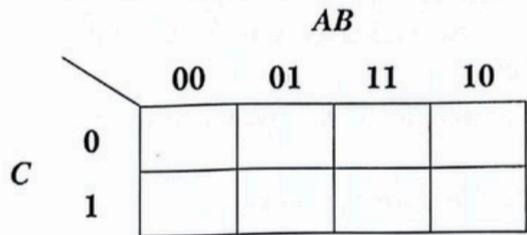
20 E II

Part B

\* Answer any four questions only.

5. (a) A circuit with three inputs (A, B, C) and one output (Z) is to be designed. The output should be equal to 1 when the binary value combination of the three inputs is either 1, 3 or 6. The output should be 0 for other cases.

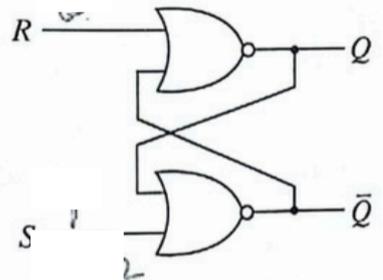
- (i) Draw the complete truth table for the above circuit.
- (ii) Complete the Karnaugh map relevant to the above circuit according to the following format:



- (iii) Using the Karnaugh map, derive the most simplified product-of-sums (POS) expression for the output Z. Show the loops clearly on the Karnaugh map.
- (iv) Draw a logic circuit for the **simplified** expression derived in (iii) by only using NOR gates assuming that the complemented inputs  $\bar{A}$ ,  $\bar{B}$  and  $\bar{C}$  are also available.

(b) Using Boolean Algebra show that  $\bar{A}C + \bar{A}B + A\bar{B}C + BC$  is equivalent to  $C + \bar{A}B$ .

- (c) Consider the flip flop circuit shown on the right.
  - (i) Assume that the S input is 1 and the R input is 0. What will be the output at Q?
  - (ii) What will be the output at Q if the S input is now made 0?
  - (iii) What will be the output at Q when the R input is now made 1?



6. (a) Draw a sketch to show how a file server (FS), a printer (P) and two computers (C1 and C2) should be connected in a star topology.

- (b) A port number is also used along with an IP address in a network communication. Why?
- (c) Consider a subnet with the network address 192.168.56.128/26.

- (i) Write an example IP address that can be assigned to a host attached to this subnet (in dotted decimal notation).
- (ii) Write the first and the last usable host addresses in this network (in dotted decimal notation).
- (iii) How many host addresses are available for use in this subnet?

(d) Suppose an Internet Service Provider owns the 192.168.56.32/26 IP address block. Assume that the provider wants to create four subnets namely, Subnet A, Subnet B, Subnet C and Subnet D from this address block with each subnet having the same number of IP addresses.

- (i) Write the subnet mask of the above given IP address block in dotted decimal notation.
- (ii) Write the number of host bits needed to create the required number of subnets.
- (iii) Once subnetting is done, fill in the following table.

Subnet	Network address	First usable IP address	Last usable IP address	Broadcast address
Subnet A				
Subnet B				
Subnet C				
Subnet D				

- (e) (i) Write two functions of a proxy server in a computer network.
- (ii) Write two properties of MAC addresses assigned to devices connected to a network.

7. (a) Assume that you are given an Arduino UNO board (Figure 7.1) along with the following items:

- Passive Infrared Sensor (PIR) for motion detection (Figure 7.2)
- Sensor for ambient light detection
- LEDs, Resistors, and a Power supply

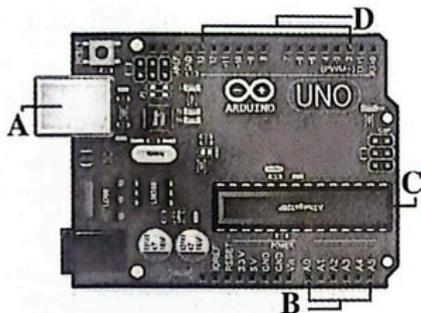


Figure 7.1

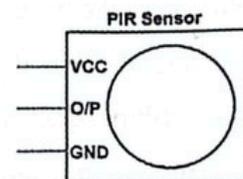


Figure 7.2

- (i) Identify the parts marked as A, B, C, and D in Figure 7.1 and briefly explain each of their functionalities.
- (ii) Assume that you want to build an IoT setup that switches an LED light on when motion is detected. It is further required to switch on this LED only during night time. Draw a schematic diagram connecting the Arduino board and the items given above as necessary in order to build this setup.

(b) An e-commerce warehouse automation system includes a set of agent-based robots which move ordered goods to their respective dispatch areas to start relevant shipments.

The Figure 7.3 shows the latter part of this system. A Quality Control (QC) Officer inspects the goods of each order as it passes on a conveyor belt and confirms to a software system (Delivery Handler Agent) that the order has passed QC. The Delivery Handler Agent directs the package to a mobile robot at the loading area. The robot agent reads the package barcode to determine the appropriate dispatch area. It then navigates the robot to the relevant dispatch area, scanning the path and avoiding obstacles while on the move. The Dispatch Handler Agent, another software, validates each package at the dispatch areas and informs the Dispatch Officer to confirm its decision. The Dispatch Officer can override Dispatch Handler decisions if needed and directs the confirmed packages to the postal division.

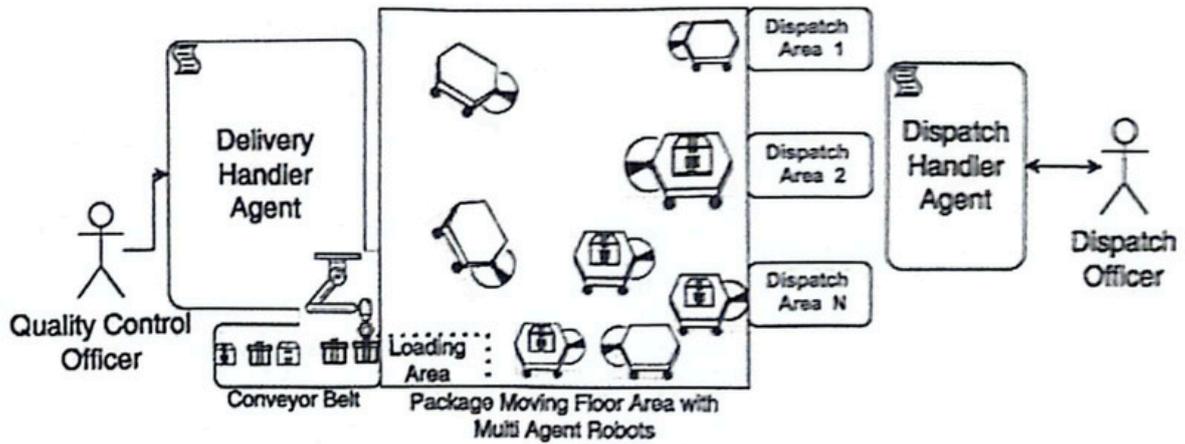


Figure 7.3

- (i) Software Agents demonstrate certain characteristics which make their behaviour unique. Briefly explain the following two characteristics of a software agent:
- autonomous
  - cooperative
- (ii) Name a self-autonomous agent and a user agent in the given example.
- (iii) If the set of multi-agent robots behave satisfying only the autonomous characteristic but fails to cooperate, write down one of the most likely observations that will be seen during their operation.
- (iv) If this system is redesigned by replacing the multi-agent behaviour with centralized control and a broker agent for communication, identify **one** main change that will be seen with respect to each of the following:
- Control of the robot mobility
  - Decision making process (relevant to moving packages from loading area to dispatch areas)
- (v) Draw a *box and arrow diagram* for the new solution with centralized control, mentioned in (iv), above.
- (Note: A box and arrow diagram uses boxes to show system components and arrows to show connections between those components)

8. (a) Write the output of the Python code given in Figure 8.1.

```
def function1(str):
    newstr = ''
    for character in str:
        if character in 'aeiouAEIOU':
            newstr += '**'
        else:
            newstr += character
    return newstr
str1 = "LibrAry"
str2 = function1(str1)
print(str2)
```

Figure 8.1

(b) The function in Figure 8.2 uses the bubblesort algorithm to sort a given list of numbers into ascending order. Write down the suitable replacements for the labels P-U to complete the code.

```
def bubbleSort(nList):
    for pNumber in range(P,Q,R):
        S:
            if nList[i]>nList[i+1]:
                temp = nList[i]
                T
                U
```

Figure 8.2

(c) An estate owner wants a program to determine the **minimum** currency note combination needed to make the pay of each employee. (E.g., Rs. 40,000 should be paid using eight notes of Rs. 5000 and not four hundred notes of Rs. 100). The program should also output the currency requirement for all employees. The program should use the **employees.txt** file which contains employee pay details. Each line in it contains an employee's name and net pay. A Python program written for this purpose is shown in Figure 8.3. A sample **employees.txt** file and the program's output for that file are shown in Figure 8.4.

(i) Write down the suitable replacements for the **ten** labels **A-J** in the program given in Figure 8.3.

```
# currency notes used in Sri Lanka
notes = [5000,1000,500,100,50,20]
# total notes required from each currency note type
totals = [0,0,0,0,0,0]

file = A('employees.txt','r')

while True:
    required = [0,0,0,0,0,0] # notes required for employee

    line = file.readline()
    if B line:
        C

        empDetails = line.split()
        netpay = int(float(D))
        if netpay < 0:
            continue

        print("\n")
        print(empDetails[0], " Net pay =", netpay)
        topay = netpay
        i = 0
        while topay > 0:
            required[i] = E
            totals[i] = totals[i] + F
            topay = G
            H

        # print employee netpay breakdown
        for i in range(0, len(required)):
            print("Rs.", notes[i], ":", I)
        J

    print("\nTOTAL REQUIREMENT:")
    for i in range(0, len(totals)):
        print("Rs.", notes[i], ":", totals[i])
```

Figure 8.3

Example 'employees.txt' file:

```
Raj 40120
Niranjala 51670
```

Program's output for that file:

```
Raj Net pay = 40120
Rs. 5000 : 8
Rs. 1000 : 0
Rs. 500 : 0
Rs. 100 : 1
Rs. 50 : 0
Rs. 20 : 1

Niranjala Net pay = 51670
Rs. 5000 : 10
Rs. 1000 : 1
Rs. 500 : 1
Rs. 100 : 1
Rs. 50 : 1
Rs. 20 : 1

TOTAL REQUIREMENT:
Rs. 5000 : 18
Rs. 1000 : 1
Rs. 500 : 1
Rs. 100 : 2
Rs. 50 : 1
Rs. 20 : 2
```

Figure 8.4

(ii) The net pay of employees in this estate, does not contain cents. However, what practical problem with respect to the net pay inputs exists in this code? What modifications will you do to fix that problem?

9. (a) Consider the following requirements relevant to a database that is expected to manage divisions, officers and tasks in an office.

The office consists of a number of divisions. Each division has a unique name. The division may have several locations. A division handles a number of tasks each of which has a unique number, a name and a date in which the task was assigned to the division. Each officer's name (consisting of a first name and a surname), NIC (National Identity Card) number, address and phone number is to be stored. An officer is assigned to one division but may work on several tasks which may not be controlled by the same division. Each division is managed by one of its officers and the starting date in which the officer started managing the division is stored. Draw an ER diagram for this application showing the entities, attributes and relationships. Underline primary keys.

- (b) Write two advantages of converting a database table into a normal form.

- (c) Consider the following Show table related to theatres and the movies that they screen.

Theatre	Movie	Day	Time	Screen	Year
Sarasi	MI - 4	Wednesday	10:00	S <sub>1</sub>	2022
Sarasi	MI - 4	Wednesday	15:00	S <sub>1</sub>	2022
Palazzo	Spider man	Friday	10:00	S <sub>2</sub>	2019
Palazzo	Avengers	Friday	10:00	S <sub>1</sub>	2019
Vega	Iron man	Thursday	10:00	S <sub>1</sub>	2020

Note:

- A theatre can screen more than one movie at the same time on different screens.
- Year field gives the year in which the relevant movie was released.

(i) .. which normal form does the Show table exist? Justify your answer.

(ii) Convert the Show table to its next normal form.

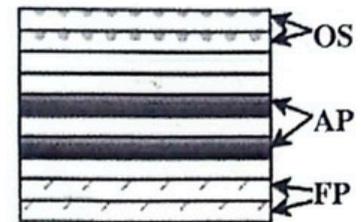
- (d) Consider the following Employee table:

Emp_ID	Emp_Name	DoB	Department	Designation	DoJ	Salary
E110	Saman	15/10/1970	Bio Technology	Professor	12/04/2001	145000
E111	Kumar	25/05/1980	Mechanical	Assistant Professor	02/05/2006	100000
E115	Raja	10/08/1982	Engineering	Assistant Professor	05/05/2001	98000
E114	Jennifer	11/09/1975	Engineering	Assistant Professor	03/06/2001	107000
E117	Ismail	15/05/1979	Civil	Assistant Professor	10/05/2005	103000

- (i) Write the most suitable SQL statement to create the Employee table with a suitable primary key.
- (ii) Write the required SQL statement to insert the record for the following employee:  
Emp\_ID = E119, Emp\_Name = "John", DoB = "15/06/1971", Department = "IT",  
Designation = "Professor", DoJ = "15/07/2001", Salary = 107000
- (iii) Write the output obtained by applying the following SQL query:  
 SELECT Emp\_ID, Emp\_Name  
 FROM Employee  
 WHERE Salary > 103000;
- (iv) Write the appropriate SQL query to find the names of all employees who work in the "Civil" department.

10. (a) (i) What is the repeating cycle that a processor in a computer is involved in since the computer is started till it is shutdown?
- (ii) Which program's instructions get executed in the processor of a computer during a *context switch*?
- (iii) A *register* is a group of binary cells suitable for holding binary information and is constituted by a collection of flip-flops. How many flip-flops are needed to make an n-bit register?
- (b) A user runs the following Python codes on a computer. The code on left prints the lines of a file on the screen while the other code does an average computation.

fileReader.py	average.py
<pre>A = input("Enter filename") f1 = open(A, "r") for line in f1:     print(line) f1.close()</pre>	<pre>total = 0 for num in range(10000):     total += num average = total / 10000 print(average)</pre>



Memory

Figure 10.1

The computer's memory at a particular time is shown in the figure 10.1. The memory frames occupied by the *operating system*, the *fileReader process* and the *average process* are indicated on it by OS, FP and AP respectively.

Selecting from OS, AP and FP, write down the most likely place where each of the following is stored.

- (i) content of variable A of the *fileReader process*
- (ii) the Process Control Block (PCB) of the *average process*
- (c) Of the above two python processes, one of them will go through the RUNNING → BLOCKED state transition more than the other. Which process is that? Give the reason for it.
- (d) Assume that when the *fileReader process* of (b) above is in progress a context switch occurs and a different process is run. When the *fileReader process* is given the chance to run again, the file is read from where it stopped. Which data structure facilitates that feature?
- (e) A computer uses 32-bit virtual addresses. This computer has a 1 GB ( $2^{30}$  bytes) physical memory and a 4 KB page size.
- (i) Write down the number of frames in physical memory as a power of 2.
- (ii) Assume that **in addition to** memory frame information, each page table entry for a virtual page in this computer contains some additional information consisting of a total of **four bits**. If the total size of the page table required for each process on this computer assuming that all virtual pages are in use is given as  $2^p \times q$  bits, write down the values of  $p$  and  $q$ .
- (iii) If the virtual address 4097 of a particular process is mapped to *Frame 2* of physical memory, write down in **decimal** form, the physical address corresponding to the virtual address 4097. (Assume that page numbers, frame numbers and addresses begin from 0)
- (f) The *test.py* file is stored on blocks 218 and 220 respectively in a disk that uses a File Allocation Table (FAT) to manage its storage. The disk uses 4 KB blocks.
- (i) Write down an important number in the *directory entry* for the *test.py* file that will help the operating system to find the blocks of the file.
- (ii) Give an example size for *test.py* that will result in *internal fragmentation*.
- (iii) Assume that block 219 is also to be added for the *test.py* file. Show in a diagram the FAT entries for the *test.py* file after this addition.  
(-1 indicates last block)