Part A – Structured Essay

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

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

```
<html>
<body>
<!--Effects of Social Networking -->
<p>Social networking has <br> <u>advantages</u> and disadvantages </p>
</body>
</html>
```

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

```
<html>
<body>
<table border="1">
<caption>Schedule</caption>
<tr><th>Time</th><th>Event</th></tr>
<tr><td>8 am</td><td>Drama</td></tr>
<tr><td>10 am</td><td>News</td></tr>
<tr><td colspan =2> Lunch</td></tr>
</table>
</body>
</html>
```

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(b) (i) Write **two** advantages of using *external style sheets* when creating a web page.

(1) .....

(2) .....

(ii) Consider the following HTML elements require the styles as given in the table.

Element Name	Attribute	Attribute Value
p	*color* *font-family* *text-align*	*red* *Calibri* *justify*
h1	*color* *font-family*	*red* *Calibri*
h2	*color* *font-family* *text-align*	*red* *Calibri* *justify*

Write an *external style sheet* in the **most efficient way** to fulfil the above requirements using only the **CSS group selector** concept.

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(c) The following PHP code is intended to add data into '**name**' and '**class**' fields of the table named '**student**' in the MYSQL database called '**school_db**'. User name and password to login to '**school_db**' are '**admin**' and '**A!2t***' respectively.

Complete the PHP code segment by filling the blanks.

```
<?php
  $conn = new mysqli('localhost', ..... , ..... , .....);
  if ($conn->connect_error) {
      die("Connection failed: " . $conn->connect_error);
  }

  $sql = "..... into ..... (..... , .....)
  values ('Piyal', '12-B')";

  if ($conn->query(.....) ==true) {
      echo "New record created successfully";
  } else {
      echo "Error: " . $sql . "<br>" . $conn->error;
  }

  $conn->close();
?>
```


[see page four

2. (a) Match each of the given phrases (i) - (vi) relating to commerce with the most suitable item from the list below:

Do not write in this column

List = {*advertising as a revenue model, credit-cards, Government e-Tendering service, Government to Citizen (G2C) service, group purchasing, harmful explosives, online marketplace, payment gateway, perishable goods, social commerce, subscription as a revenue model, traditional marketplace*}

Phrases:

(i) a place where buyers and sellers interact physically for exchanging goods and services for a price

(ii) these are usually prohibited to be sold or purchased through e-commerce systems

(iii) users pay a regular fee to have full access to a website of a business

(iv) a subset of e-commerce that involves using social media to assist in the online buying and selling of products and services

(v) facilitates a payment transaction by the transfer of information between the e-commerce application and the back-end financial service providers through secure means

(vi) the renewal of vehicle revenue licence using the Online Vehicle Revenue Licence Service offered by the relevant government office

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

(i) .....

(ii) .....

(iii) .....

(iv) .....

(v) .....

(vi) .....

(b) Consider the following Python program:

```
x = 0
n = int (input ( ))
while (n > 0):
        if  n > x:
                x = n
        n = int (input ( ))
print (x)
```

(i) Write the output of the program if the input is 4 6 3 2 8 –1.

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(ii) What is the purpose of this program?

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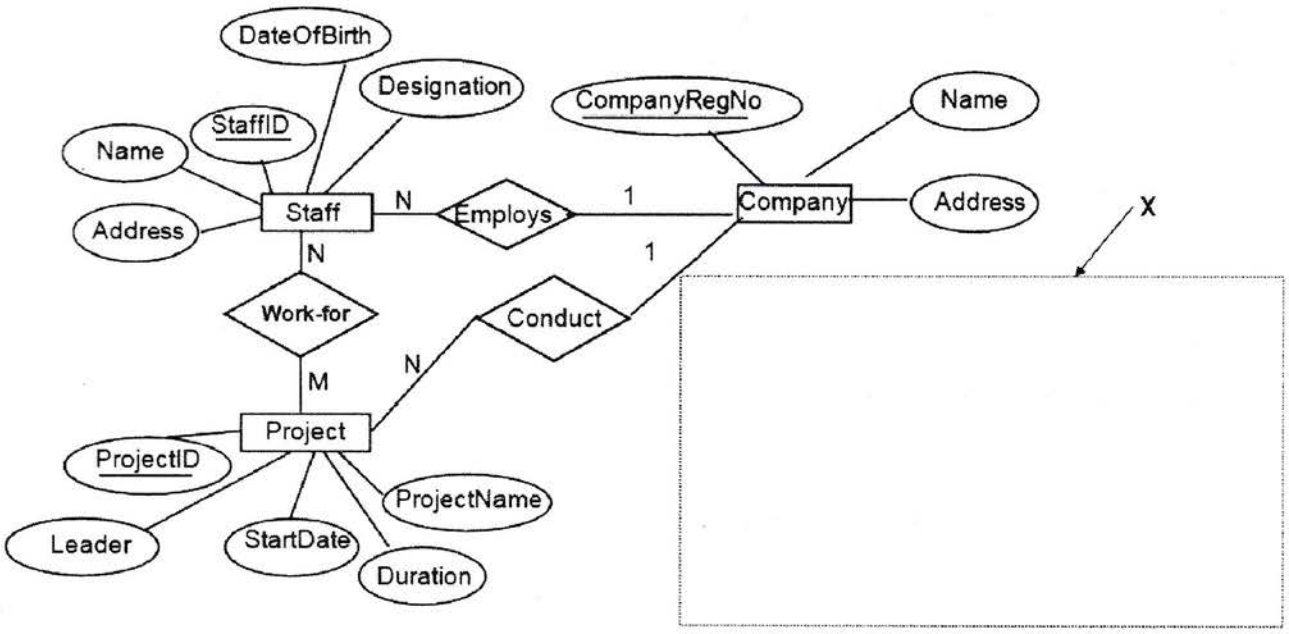
3. (a) Consider the following Entity Relationship (ER) diagram which represents the information about projects conducted by staff attached to a software development company.



(i) The number of hours (*NoOfHours*) that each staff member works on each project is recorded.
Draw the attribute *NoOfHours* in the relevant position of the ER diagram with the correct symbol and the label.

(ii) For each accepted project, a temporary location is rented for the staff, for the duration of the project. For each Location, the OwnerName, PhoneNo, Address, Rent, RentedDate and RentedPeriod are recorded. One project has only one location. A rented location is used for only one project. When a certain project is completed, the location rented for the project will be released and handed over to the owner.
Draw the Entity 'Location' with relevant attributes inside the area X in the diagram and link it to the existing ER diagram by indicating the cardinality.

(b) Write down the most appropriate term from the given list to fill the blank in each statement given below.

List = {*ALOHA, Application Layer, CIDR, DHCP, Domain Name System, Network Layer, Packet Switching, Parity Bit, Parity Byte, Proxy Server*}

(i) ..... provides IP addresses for the given URLs and web addresses.

(ii) File Transfer Protocol (FTP), Simple Mail Transfer Protocol (SMTP) and the Telnet service are implemented in the ..... .

(iii) With the ..... a device may get a different IP address every time it connects to the network.

(iv) ..... helps to effectively manage the available IP address space.

(v) In data transmission, for the process of error detection, a ..... is added to a binary string to ensure that the total number of 1-bits in the string is either even or odd.

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4. (a) An operating system uses *Process Control Blocks* (*PCBs*) to maintain important information about each process.

Read the following scenario and answer the given questions:

Rani starts a computational application on a single processor computer. While the relevant computations are in progress, she starts a web browser application as well, in order to search for some information.

Write down the content that will be stored in the following PCB fields of the ***computing process*** when the "*computing process* → *web browser process*" context switch is made.

(i) Program counter

.....

(ii) Process state (*Ready*, *Running* or *Blocked*?)

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(b) (i) What is meant by *contiguous file space allocation*?

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(ii) Write down **one** drawback of *contiguous file space allocation*.

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(iii) However, contiguous allocation is feasible to store a set of files on a CD ROM. Why?

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(iv) In addition to the normal data items, write down **one** other information that will exist in a file block in the *linked file space allocation scheme*.

.....

(c) Assume that a 32 KB program is run on a computer having 32 KB of physical memory. The page size of the system is 4 KB. The page table of this process at a particular time is shown on the table below.

Notes:

- Only a few selected fields of each page table entry is shown.
- The *frame number* is indicated in binary.
- The virtual addresses on page 0 are from 0 to 4095 and on page 1 are from 4096 to 8191 and so on.
- The *Present/absent* bit indicates the validity of the entry. If this bit is 1, the entry is valid and can be used. If it is 0, then the relevant virtual page is not in physical memory.

Page number	Frame number	Present / absent
0	110	1
1	001	1
2	010	1
3	100	1
4	011	1
5	000	0
6	000	0
7	101	1

[see page seven

(i) Assume this program requires accessing virtual address 8200. To which physical address will it get transformed to?

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(ii) Write down **one** advantage that the use of page tables bring with respect to program sizes compared to the size of physical memory.

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(iii) Give **one** reason as to why a particular page of a process could be absent in physical memory.

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கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2019 ஓகஸ்ற்
General Certificate of Education (Adv. Level) Examination, August 2019

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தகவல், தொடர்பாடல் தொழினுட்பவியல் II
Information & Communication Technology II

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Part B

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

1. The Boolean function known as the *majority function* takes n binary inputs and outputs 1 if a majority (at least half) of the inputs are 1, otherwise it outputs 0. Let us consider the case when n=3, which is the 3-input majority function, whose inputs are A, B and C and the output is Z.

(a) Give the truth table for the 3-input majority function.

(b) Using Karnaugh maps, derive a simplified Boolean expression for the output Z in the 3-input majority function.

(c) Construct a logic circuit for the 3-input majority function using NAND gates only.

2. Consider the following scenario:

A school has acquired the following resources to its *Administrative* (*Admin*), *Laboratory* (*Lab*) and *Library* (*Lib*) buildings:

Building	Resources
Admin	5 computers, 1 printer
Lab	40 computers, 1 printer
Lib	10 computers, 1 printer

A school computer network has to be created to fulfil the following requirements:

- Each building needs to have its own local area network (LAN) in order to share the printer.
- The above three networks are also to be interconnected so that the School Information System (SIS) which is running on one computer in the *Admin* building and the Library Information System (LIS) running on one computer in the *Lib* building are accessible from all computers.
- All computers are to be given efficient Internet connectivity as well. For this purpose, the school has subscribed to an Internet Service Provider (ISP) who is to supply the Internet connectivity to the *Lab* building. The *Lab* building is separated from the other two buildings by approximately 500m. One computer in the *Lab* building is to be used as the DNS server. Another computer in the *Lab* building is to be used as the proxy server.
- The entire network is to be protected through a firewall.

(a) The Principal has received the 192.248.16.0/24 IP address block for the school. The IP addresses for the computers are to be allocated after making three subnets from this address block for the three buildings.
Assuming such subnetting is done, write down the relevant network address, subnet mask and the allocated range of IP addresses for each building using the following table format to present your answer:

Building	Network Address	Subnet Mask	IP Address Range
Admin			
Lab			
Lib			

(b) Give **one** reason as to why a fully connected (all-to-all) network topology is not suitable for this school computer network.

(c) The Lab administrator who is responsible to setup the school computer network has requested for *switches* and a *router*.

Showing clearly the network connection topology and the devices, draw the network diagram to represent the logical arrangement for the school computer network that the Lab administrator can implement to fulfil the school requirements.

(d) Give **one** reason as to why TCP is preferred over UDP as the transport protocol for the school computer network.

3. (a) ABC Books (Pvt.) Ltd. specializes in buying and selling used secondhand books. At present the business operations are fully manual (*pure brick*).

(i) ABC Books (Pvt.) Ltd. starts a website and allows its customers to purchase books online. What is the revenue model (method of revenue) applicable in this scenario?

(ii) Moving from *pure brick* type to *brick and click* business model, what is the most significant challenge unique to ABC's business? Explain your answer.

Hint – Compare with the online sales of new books

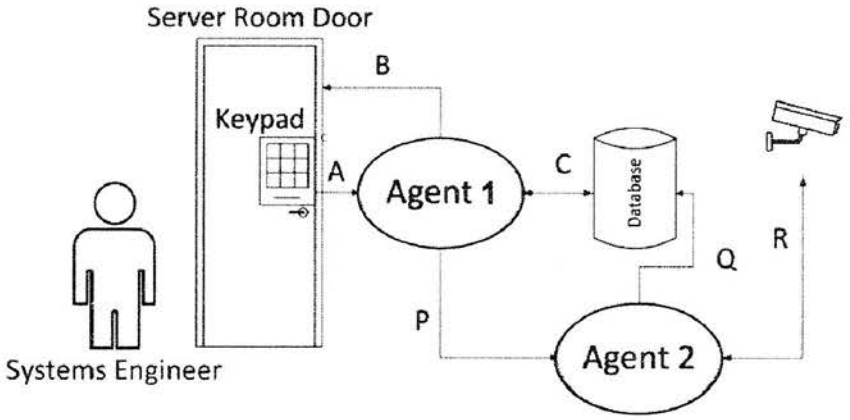
(iii) ABC Books (Pvt.) Ltd. has proposed to extend its website to an e-commerce marketplace for used books. This marketplace supports B2C, B2B and C2C business types and allows other businesses to participate as well. Explain briefly between whom the transactions in each of the business types B2C, B2B and C2C will take place in the proposed marketplace.

(iv) Other than the revenue model you mentioned in (i) above, identify another suitable revenue model to be followed by the ABC Books (Pvt.) Ltd. in their proposed e-commerce marketplace.

(v) Identify and write down a possible way to make payments within this e-commerce marketplace.

(vi) Briefly explain how book publishing companies can use the proposed e-commerce marketplace data for their businesses.

(b) Multi-agent systems can be useful when complex system interactions are implemented. The following diagram shows a simplified version of a multi-agent system that manages the secure access to the server room of a data-center.



A brief scenario of the usage is as follows:

All authorized system engineers must use their access code, which is a 6-digit number to enter the restricted server room.

When the access is granted to the server room, a set of movable CCTV cameras starts recording the server area.

The processed data of CCTV input are saved in the database. Interactions are shown using A, B, C, P, Q, and R arrows.

(i) Identify the agent with no user interactions (self-autonomous) in this setup.

(ii) Sense-Compute-Control is a widely used 3-step design style of agent-based system implementations.

From A, B and C interactions, separately identify and write down the most suitable interaction arrow to represent each step, i.e., Sense, Compute, and Control.

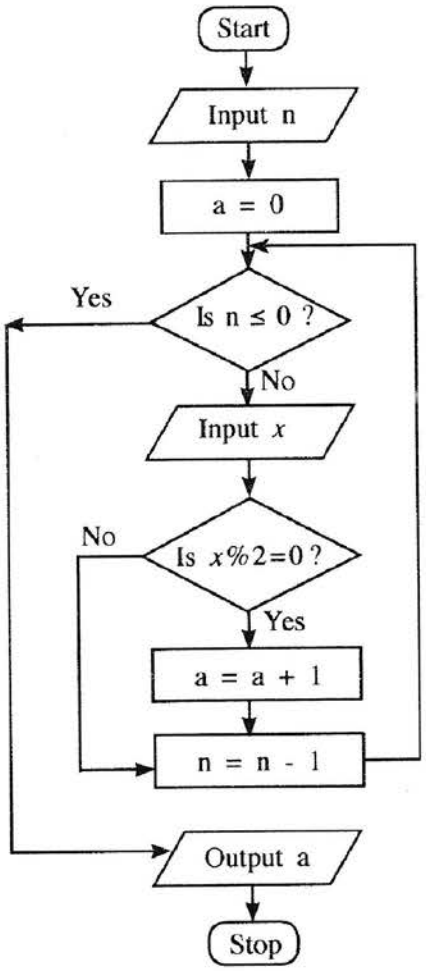
(iii) C and R interaction links are shown for two directions. Explain the reasons for the duplex links for both C and R interactions separately.

(iv) Interaction A can be seen as a *user-to-agent* interaction. Identify an *agent-to-agent* interaction and explain the operational use of that interaction.

(v) Give **one** reason as to why the CCTV inputs are sent to the database through the Agent 2 instead of sending directly.

4. (a) The ICT teacher in a school needs to process the marks obtained by all the students in a class for the ICT subject and compute the average mark for the class. Construct a flow chart to express an algorithm for this purpose. Assume that the first input is the number of students in the class, n. Next, the marks of n students will be input one-by-one.

(b) Consider the flow chart given below. Note that $x\%2$ represents (x mod 2).



(i) What would be the output if the first input (n) was 6 and the next inputs were 3, 6, 4, 12, 11, 9?

(ii) What is the purpose of this algorithm?

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

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5. A vehicle rental company has registered vehicle owners. Vehicles are obtained from the owners and rented to the customers. Consider the following relations regarding the vehicle rental company.

I. Customer (Customer_NIC, Customer_Name, City, Postal_Code)

II. Vehicle_Owner (Owner_Id, Owner_Name, Contact_No)

III. Vehicle(Vehicle_Reg_No, Description, Owner_Id)

- The Customer relation contains customer's national identity card number (NIC) which is unique, name, city where he/she is living and the postal code of the city. A customer lives in a single city and there are many customers in one city. The postal code depends on the city.
- The Vehicle_Owner relation contains the Owner_Id which is unique, owner's name and the contact number.
- The Vehicle relation contains the vehicle registration number which is unique, a description about the vehicle and the Owner_Id.

A customer can rent more than one vehicle. Also, it is possible to rent one vehicle to many customers at different instances. Each vehicle is owned by one owner and one owner can have more than one vehicle.

(a) In which *normal form* do the above relations given in I, II, III above exist? Justify your answer.

(b) Convert the above relations to the next *Normal Form* from the current *Normal Form* which you have stated in 5(a). (Present the contents relevant to the labels Ⓟ to Ⓤ indicated in the following table as your answer.)

Relation No.	Next Normal Form	Relation/s in Next Normal Form
I	Ⓟ	Ⓢ
II	Ⓠ	Ⓣ
III	Ⓡ	Ⓤ

(c) Draw an Entity Relationship (ER) diagram to depict the above relations by identifying the relationships, key attributes, other attributes and the cardinality.

(d) It is necessary for the company to keep the details of renting vehicles by customers. Create a relation called "Rent", including the details Rent_Date, Start_Time and End_Time.

(e) Write an SQL statement to select Owner_Id and Vehicle_Reg_No of all the vehicles owned by each vehicle owner.

6. (a) A blood testing centre has the following activities:

The patient hands over the test request slip to the receiving counter. Receiving counter issues an invoice to the patient and sends a copy to the cashier. The patient checks the invoice, approves it and hands it over to the cashier with the payment. Cashier issues a receipt to the patient and also sends a copy of the receipt to the laboratory. Patient hands over the receipt to the laboratory. The laboratory verifies the patient and conducts the blood test and returns the updated receipt marked as 'done' to the patient. The laboratory sends the report to the receiving counter. Later, the patient hands over the updated receipt to the receiving counter and the receiving counter hands over the report to the patient with the re-updated receipt marked as 'issued'.

(i) The *context diagram* for the above activities, with missing *data flows* Ⓟ, Ⓠ, Ⓡ, Ⓢ and Ⓣ, is given in Figure 1 below.

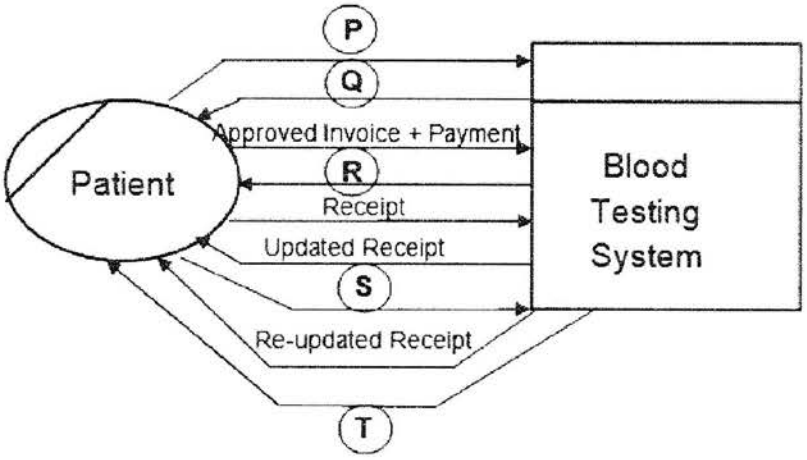

Figure 1

Identify the **five** missing *data flows* from the description given above and write them down.

(ii) Level 1 of the DFD for the above context diagram is shown in Figure 2.

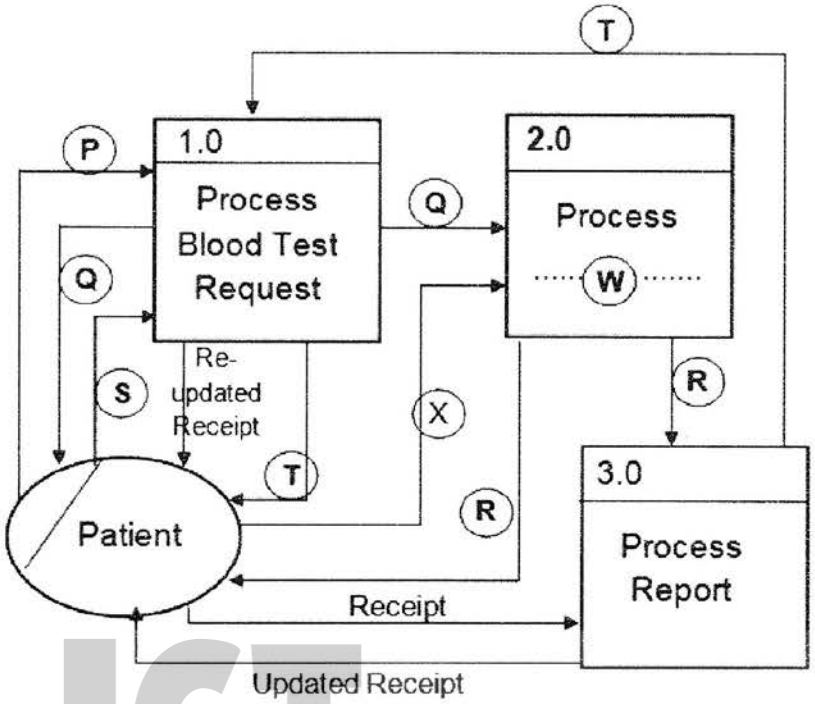

Figure 2

(A) Write a suitable term to replace the label Ⓦ in Process 2.0.

(B) Identify and write down the missing data flow labelled Ⓧ.

(b) (i) What is *requirement analysis*?

(ii) List **two** advantages of requirement analysis.

(iii) Give **one** method that can be used to verify whether a functional requirement is satisfied in a system.

(iv) The following list consists of some *functional*, *non-functional* and other requirements of a proposed school library management system where users can borrow and return books in addition to other usual tasks.

(A) The system should authenticate users through username and password.

(B) The system should enable users to search for books based on the *title*, *type*, *ISBN No.* or *publisher name*.

(C) The total cost for the library system should be less than Rs. 500 000.00.

(D) The system should be available 99% of the total time.

(E) The system development should be completed within 9 months.

(F) Book lending details should be preserved even if the system crashes during operation.

(G) The book database of the school library management system must be secured by preventing unauthorized access.

(H) Since the Past Pupils Association has indicated its willingness to develop the system, preference will be given to them.

From A to H, identify and write down the labels of **two** *functional* requirements and **two** *non-functional* requirements respectively.

* * *

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