Theory Based Model Questions – Answers

Question 01 –

(a) The process of a typical software development lifecycle involves several stages. Fill in the missing stages in the correct order.

- **1st stage** is: Requirements gathering
- **2nd stage** is: Design
- **3rd stage** is: Implementation (or Coding)
- **4th stage** is: Deployment

(b)
(i) The use of Machine Learning models in various applications requires the processing and analyzing of vast amounts of data. Which type of cloud service is most appropriate for running these Machine Learning tasks, and why?
Answer: Platform as a Service (PaaS) is the most suitable cloud service model for running Machine Learning tasks because it provides an integrated environment with the necessary tools and infrastructure for development, deployment, and management of applications without the complexity of maintaining the underlying hardware.

(ii) Autonomous vehicles use a combination of sensors and data processing to make real-time driving decisions. Identify and explain a suitable network model that allows these vehicles to communicate effectively and ensure safety.
Answer: Edge Computing is the suitable network model for autonomous vehicles. It allows data to be processed closer to the source (i.e., the vehicle), reducing latency and enabling real-time decision-making, which is critical for the safety and performance of self-driving cars.

(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 - SaaS, 2 - PaaS, 3 - IaaS, 4 - Edge Computing, 5 - Data Warehouse, 6 - Blockchain, 7 - IoT Device, 8 - VPN, 9 - Web Server}

(i) A secure and encrypted communication channel over the internet is provided by **8 - VPN**.
(ii) The concept of storing data in a large, organized, and efficient manner for analytics is referred to as **5 - Data Warehouse**.
(iii) In **4 - Edge Computing**, data is processed closer to where it is generated, reducing latency and improving response times.
(iv) A service model that provides virtualized computing resources over the internet is known as **3 - IaaS**.
(v) A distributed ledger technology used for secure and transparent transactions is called **6 - Blockchain**.

(d)
(i) Your friend believes that 'software piracy' is a beneficial act since it provides access to expensive software for free. Explain to your friend why software piracy is considered unethical and harmful.
Answer: Software piracy is unethical and harmful because it deprives developers and companies of fair compensation for their work, leading to financial losses. It also discourages innovation and can harm the economy. Additionally, pirated software often lacks proper security updates, exposing users to cyber threats and malware.

(ii) Many devices contribute to e-waste in the modern world. Suggest a sustainable practice that can help manage e-waste effectively.
Answer: A sustainable practice for managing e-waste is to implement recycling programs that responsibly dispose of and recycle electronic components. Encouraging the use of certified e-waste recycling centers helps recover valuable materials while minimizing environmental impact.

Question 02

(a) The OSI (Open Systems Interconnection) model is fundamental in understanding computer networking. Complete the following blanks with the correct OSI model layers:

- **Layer 1** is: Physical Layer
- **Layer 4** is: Transport Layer
- **Layer 7** is: Application Layer

(b)
(i) Explain the role of a proxy server in a computer network. Provide two specific examples of how it can be used.
Answer: A proxy server acts as an intermediary between a user's device and the internet, managing and filtering requests. It can be used for monitoring and filtering internet traffic, improving security by anonymizing user activity, and caching frequently accessed content to enhance performance. For example, a company might use a proxy server to restrict access to specific websites, or an individual could use one to hide their IP address when browsing online.

(ii) Describe the significance of using data encryption in online transactions. Name one widely-used encryption protocol.
Answer: Data encryption ensures the confidentiality and security of information being transmitted over the internet by converting it into a secure format that can only be read by authorized parties. This is crucial for protecting sensitive data, such as credit card details, from cybercriminals. A widely-used encryption protocol is TLS (Transport Layer Security).

(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 - Full Backup, 2 - Incremental Backup, 3 - Differential Backup, 4 - Router, 5 - Switch, 6 - Firewall, 7 - IMAP, 8 - SMTP, 9 - POP3}

(i) A device that forwards data packets between different networks is called a **4 - Router**.
(ii) An email protocol used to retrieve messages and keep them on the mail server is **7 - IMAP**.
(iii) A backup method that copies only the data changed since the last full backup is referred to as **2 - Incremental Backup**.
(iv) A security system designed to prevent unauthorized access to or from a private network is known as a **6 - Firewall**.
(v) An email protocol used to send messages from a client to a mail server is **8 - SMTP**.

(d)
(i) Your friend is confused about the difference between RAM and ROM. Briefly explain the difference to your friend, mentioning the purpose of each type of memory.
Answer: RAM (Random Access Memory) is a type of volatile memory used to temporarily store data and instructions that a computer needs while running programs, allowing for quick access and processing. In contrast, ROM (Read-Only Memory) is non-volatile and permanently stores essential instructions, like the BIOS, that the computer needs to boot and function correctly. RAM loses its data when the computer is turned off, while ROM retains it.

(ii) Discuss one environmental impact of using non-biodegradable computer components and suggest a way to minimize this impact.
Answer: Non-biodegradable computer components contribute to electronic waste, which can release harmful toxins into the soil and water, impacting ecosystems and human health. One way to minimize this impact is by recycling e-waste through certified facilities that safely recover reusable materials and properly dispose of hazardous substances.

Question 03

(a) Database Management Systems (DBMS) are crucial in handling data effectively. Complete the following statements about the features and functions of a DBMS:

- A DBMS ensures data **security** to prevent unauthorized access.
- The process of automatically backing up data at regular intervals is known as **scheduled backup**.
- A **primary key** is a unique identifier for a **record (or row)** in a table.

(b)
(i) Explain the concept of normalization in a database and describe why it is essential.
Answer: Normalization is the process of organizing data in a database to minimize redundancy and improve data integrity. It involves dividing large tables into smaller, related tables and defining relationships between them. This ensures efficient data organization, reduces data anomalies, and improves overall database performance.

(ii) Describe the difference between **inner join** and **left outer join** in SQL, providing a brief example for each.
Answer:

- **Inner Join**: An inner join returns only the rows where there is a match in both tables.
  Example: If we have two tables, Students and Enrollments, an inner join would only return students who are enrolled in a course.

```
SELECT Students.Name, Enrollments.Course
FROM Students
INNER JOIN Enrollments
ON Students.StudentID = Enrollments.StudentID;
```

- **Left Outer Join**: A left outer join returns all the rows from the left table and the matching rows from the right table. If no match is found, NULL values are returned for the right table's columns.
  Example: Using the same tables, a left outer join would return all students, including those who are not enrolled in any course.

```
SELECT Students.Name, Enrollments.Course
FROM Students
LEFT JOIN Enrollments
ON Students.StudentID = Enrollments.StudentID;
```

(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 - Foreign Key, 2 - Entity-Relationship Diagram, 3 - Composite Key, 4 - Data Redundancy, 5 - Referential Integrity, 6 - Stored Procedure, 7 - Trigger, 8 - Data Warehouse, 9 - View}

(i) A visual representation used to design and model database structure is called an **2 - Entity-Relationship Diagram**.
(ii) A field that creates a relationship between two tables and enforces data consistency is known as a **1 - Foreign Key**.
(iii) A set of SQL statements that execute automatically in response to specific events within the database is called a **7 - Trigger**.
(iv) The concept that ensures that relationships between tables remain consistent is referred to as **5 -**

Referential Integrity.
(v) A virtual table that displays a subset of data from one or more tables is called a **9 - View**.

(d)
(i) Your classmate does not understand why backup strategies are essential in a DBMS. Briefly explain the importance of regular backups and give an example of a backup method.
Answer: Regular backups are crucial in a DBMS to protect against data loss caused by hardware failure, human error, or cyber-attacks. They ensure that data can be restored to its previous state, minimizing the impact of data corruption or loss. An example of a backup method is a full backup, where all data is copied and stored in a separate location.

(ii) Discuss one ethical concern related to data privacy in the context of using social media platforms and suggest a way to address this concern.
Answer: One ethical concern is the misuse of personal data by social media platforms, which can lead to privacy violations, such as targeted advertising or data breaches. To address this, platforms should implement stricter data privacy policies and allow users more control over their data, including the ability to easily opt out of data collection.

Question 04 –

(a) In computer architecture, the Central Processing Unit (CPU) performs critical functions. Complete the following statements about the components and functions of a CPU:

- The **ALU** (Arithmetic Logic Unit) is responsible for performing arithmetic and logical operations.
- The **CU** (Control Unit) manages the execution of instructions by directing the operation of the other components of the CPU.
- Registers are small, fast storage locations within the CPU that hold data and instructions temporarily during processing.

(b)
(i) Explain the difference between **volatile memory** and **non-volatile memory**, providing one example of each.
Answer: Volatile memory is a type of memory that loses its contents when the power is turned off. An example of volatile memory is **RAM** (Random Access Memory). Non-volatile memory retains its contents even when the power is off. An example of non-volatile memory is **ROM** (Read-Only Memory) or an **SSD** (Solid State Drive).

(ii) Describe how cache memory improves the performance of a computer system.
Answer: Cache memory improves the performance of a computer system by providing faster data access to the CPU. It stores frequently accessed data and instructions so that the CPU can retrieve them quickly, reducing the time needed to fetch data from the main memory and speeding up overall system performance.

(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 - Static RAM, 2 - Dynamic RAM, 3 - SSD, 4 - HDD, 5 - Virtual Memory, 6 - PCIe, 7 - Data Bus, 8 - Address Bus, 9 - Control Bus}

(i) A type of non-volatile storage that uses flash memory and is faster than a traditional hard disk is known as **3 - SSD**.
(ii) The connection pathway used to transfer data between the CPU and memory is called **7 - Data Bus**.
(iii) A type of volatile memory that needs to be refreshed periodically to retain data is **2 - Dynamic RAM**.
(iv) A method of extending physical memory by using storage space on a disk is referred to as **5 - Virtual Memory**.
(v) A bus that carries the address of the memory location being accessed is called **8 - Address Bus**.

(d)
(i) Your friend is confused about how an **interrupt** works in a computer system. Briefly explain what an interrupt is and give an example of when it might be used.
Answer: An interrupt is a signal sent to the CPU that temporarily stops the current process so that a high-priority task can be executed. After the interrupt is handled, the CPU resumes the original process. An example of an interrupt is when a user presses a key on the keyboard while a program is running, causing the CPU to pause and process the key press.

(ii) Discuss one environmental impact of excessive energy consumption by data centers and suggest a way to mitigate this issue.
Answer: Excessive energy consumption by data centers leads to high carbon emissions, contributing to global warming and environmental degradation. One way to mitigate this issue is by using energy-efficient hardware and implementing cooling solutions such as liquid cooling or using renewable energy sources to power data centers.

Question 05 –

(a) The Internet of Things (IoT) has transformed how devices interact in everyday environments. Fill in the blanks in the following statements related to IoT:

- IoT devices often communicate using **wireless communication technologies** (e.g., Wi-Fi, Bluetooth, or Zigbee).
- A **sensor** is an IoT component that collects data from the physical environment.
- The term **Edge Computing** refers to the processing and analysis of data close to where it is generated to reduce latency.

(b)
(i) Describe how a **B2B (Business-to-Business)** e-commerce model operates, and give one example of a B2B transaction.
Answer: The B2B e-commerce model involves transactions between businesses, where companies sell goods or services to other companies. This model typically includes wholesale transactions, supply chain management, and procurement processes. An example of a B2B transaction is a furniture manufacturer purchasing raw materials like wood and fabric from a supplier.

(ii) Explain the **G2E (Government-to-Employee)** e-commerce model and describe one potential benefit it offers.
Answer: The G2E e-commerce model refers to the online interactions between government agencies and their employees. This model can involve providing employees with access to HR services, training materials, or internal communication tools. One potential benefit is increased efficiency, as employees can quickly access necessary information and services online, saving time and reducing paperwork.

(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 - C2C, 2 - G2G, 3 - B2E, 4 - G2C, 5 - B2C, 6 - Edge Computing, 7 - Actuator, 8 - Software Agent, 9 - Sensor}

(i) An IoT component that performs actions in response to received signals is called an **7 - Actuator**.
(ii) A software entity that autonomously performs tasks on behalf of a user is known as a **8 - Software Agent**.
(iii) A model where citizens interact with government services online is referred to as **4 - G2C**.
(iv) A system that allows businesses to sell directly to individual customers is called **5 - B2C**.
(v) A type of computing that processes data near its source rather than in a centralized data center is called **6 - Edge Computing**.

(d)

(i) Your friend is curious about the concept of **software agents**. Briefly explain what a software agent is and provide one example of how it can be used in an online shopping environment.

Answer: A software agent is a program that acts autonomously on behalf of a user to perform specific tasks. In an online shopping environment, a software agent can be used to monitor prices and notify the user when a product goes on sale or becomes available, helping the user make purchasing decisions.

(ii) Discuss one security concern related to IoT devices and suggest a method to mitigate this risk.

Answer: One security concern related to IoT devices is the risk of unauthorized access or hacking, as these devices are often connected to the internet and may have weak security measures. To mitigate this risk, strong encryption and secure authentication methods should be used, along with regular firmware updates to patch vulnerabilities.

Question 06 –

(a) Write down the most suitable items from the given list for the following statements:
List: {cloud storage, edge computing, IoT devices, data encryption}

(i) Data encryption is used to ensure that sensitive information is secure and protected from unauthorized access.
(ii) IoT devices refers to devices that are connected to the internet and can collect and exchange data.

(b) Write the most appropriate word or phrase to answer the following questions based on the description given below.

The new online ticket reservation system introduced for public transportation in Sri Lanka has revolutionized booking convenience. The system requires significant server capacity during peak hours (e.g., morning and evening rush hours) but remains underutilized during off-peak hours. This leads to challenges in maintaining cost-effective infrastructure.

(i) One of the solutions considered is to permanently invest in server hardware to handle peak loads. What is the main disadvantage of this approach?
Answer: The main disadvantage of this approach is **high costs and inefficiency, as the hardware remains underutilized during off-peak hours, leading to wasted resources and increased operational expenses.**

(ii) What is an alternative solution to efficiently handle the varying resource demands mentioned in (b)(i) while maintaining system performance?
Answer: An alternative solution is to use **cloud computing or a scalable cloud infrastructure,** which allows dynamic allocation of resources based on demand. This approach ensures cost-efficiency as the system can scale up during peak times and scale down during off-peak hours.

Question 07 –

(a) Write down the most suitable items from the given list for the following statements:
List: {smart home systems, vehicle-to-vehicle communication, smart agriculture, environmental monitoring}

(i) Smart home systems refers to the use of IoT technology to automate and manage systems within a household, such as lighting and security.
(ii) Smart agriculture uses IoT sensors to collect data and improve crop yield and efficiency in farming practices.

(b) Write the most appropriate word or phrase to answer the following questions based on the description given below.

A new smart city project has been launched to manage urban infrastructure efficiently. The project uses IoT-based environmental sensors to monitor air quality, noise levels, and energy consumption in real time. However, it has been observed that during certain times, such as festivals or events, the network experiences high traffic, while it remains underutilized at other times.

(i) One approach is to maintain a fixed amount of network bandwidth for the sensors, which is designed to handle peak usage. What is the main disadvantage of this approach?
Answer: The main disadvantage is the **inefficient use of resources**, as the network bandwidth will remain underutilized during off-peak times, leading to unnecessary costs and wastage of resources.

(ii) Suggest an alternative solution to overcome the disadvantage mentioned in (b)(i) that efficiently manages varying network demands.
Answer: An alternative solution is to implement **cloud-based elastic resource allocation**, where network resources can be dynamically scaled up or down based on real-time demand. This approach ensures cost-effectiveness while maintaining optimal performance during both peak and off-peak times.

Answers – Python Based Model Questions

Question - 01

(a) Consider the following Python code snippet:

```
def compute_values(n):
    values = []
    for i in range(3, n):
        if i % 3 == 0:
            values.append(i)
    print(values)

compute_values(20)
```

(i) What is the output of the above Python code?

Answer: `[3, 6, 9, 12, 15, 18]`

(ii) Modify the above code so that the condition `if i % 3 == 0:` is replaced with `if i % 2 == 0:`. Write down the new output.

Answer: `[4, 6, 8, 10, 12, 14, 16, 18]`

(b) The code below is designed to find the smallest value in a list of integers. Fill in the blanks with appropriate Python code to make it work correctly.

```
def find_smallest(myList):
    smallest = Ⓐ
    for i in Ⓑ:
        if i < Ⓒ:
            smallest = Ⓓ
```

- (A): `myList[0]`
- (B): `myList`
- (C): `smallest`
- (D): `i`
- (E): `smallest`
- (F): `list1`

Explanation:

- (A): Initializes `smallest` with the first element of the list.
- (B): Iterates through the entire list `myList`.
- (C): Compares each element `i` with `smallest`.
- (D): Updates `smallest` if `i` is smaller.
- (E): Prints the final smallest value.
- (F): Passes `list1` to the `find_smallest` function.

Question - 02

(a) What is the output of the following Python code?

```
text = "A/Level Python Exam"
result = ""
for char in text:
    if char in ("A", "/", "E", "x", "m"):
        pass
    else:
        result += char
print(result)
```

Answer: `"Level Python Ea"`

(b) What code line(s) in part (a) is/are to be modified to get `"A/Exam"` as the output?

1. Change `if char in ("A", "/", "E", "x", "m"):` to `if char not in ("A", "/", "E", "x", "m"):`
2. Replace `pass` with `result += char`
3. Remove the `else:` block and its contents.

(c) Fill in the blanks for the following Python code. Assume that the purpose is to append the content of one text file (file1) to another text file (file2):

```
file1_name = input("Enter the name of the
first text file: ")
file2_name = input("Enter the name of the
second text file: ")

f1 = open(file1_name, "r")
f2 = open(file2_name, "a")

for line in f1:
    f2.write(line)

f1.close()
f2.close()
```

- **First blank:** `file1_name`
- **Second blank:** `file2_name`
- **Third blank:** `f1`
- **Fourth blank:** `line`
- **Fifth blank:** `close()`
- **Sixth blank:** `close()`

Question - 03

(a) What is the output of the following Python code snippet?

```
def calculate_sum(limit):
    total = 0
    for number in range(1, limit + 1):
        if number % 4 == 0:
            total += number
    print(total)

calculate_sum(16)
```

Answer: `40`

Explanation: The numbers divisible by 4 between 1 and 16 are 4, 8, 12, and 16. Their sum is 4 + 8 + 12 + 16 = 40.

(b) Modify the above code so that it only adds numbers that are **not** divisible by 4. Write down the new output.

1. **Modified code line(s):** `if number % 4 != 0:`
2. **New output:** `96`

Explanation: The numbers **not** divisible by 4 between 1 and 16 are 1, 2, 3, 5, 6, 7, 9, 10, 11, 13, 14, 15. Their sum is 96.

(c) The code below is meant to read and process data from a text file. Complete the blanks to ensure the code correctly counts the number of lines in a text file:

```
file_name = input("Enter the name of the
text file: ")

f = open(file_name, "r")
line_count = 0

for line in f:
    line_count += 1

print("Total number of lines:", line_count)

f.close()
```

- **First blank:** `file_name`
- **Second blank:** `line_count += 1`
- **Third blank:** `line_count`
- **Fourth blank:** `close()`

Question - 04

(a) Analyze the following Python code and state the output:

```
def check_prime(n):
    if n < 2:
        return False
    for i in range(2, n):
        if n % i == 0:
            return False
    return True

def count_primes(limit):
    prime_count = 0
    for number in range(1, limit + 1):
        if check_prime(number):
            prime_count += 1
    print(prime_count)

count_primes(10)
```

Answer: 4

Explanation: The prime numbers between 1 and 10 are 2, 3, 5, and 7, so the count is 4.

(b) Modify the `count_primes` function so that it returns the sum of all prime numbers instead of counting them. Write the modified code and the new output.

1. **Modified code:**

```
def count_primes(limit):
    prime_sum = 0
    for number in range(1, limit + 1):
        if check_prime(number):
            prime_sum += number
    print(prime_sum)
```

2. **New output:** 17

Explanation: The prime numbers between 1 and 10 are 2, 3, 5, and 7. Their sum is $2 + 3 + 5 + 7 = 17$.

(c) The following code snippet is designed to read a list of integers from a text file and calculate the average. Fill in the blanks to make the code work correctly:

```python
file_name = input("Enter the name of the
text file: ")
f = open(file_name, "r")

numbers = []
for line in f:
    numbers.append(int(line.strip()))

average = sum(numbers) / len(numbers)
print("The average is:", average)

f.close()
```

- **First blank:** `file_name`
- **Second blank:** `line.strip()`
- **Third blank:** `numbers`
- **Fourth blank:** `close()`

Explanation:

- `file_name`: Refers to the name of the text file provided by the user.
- `line.strip()`: Removes any extra whitespace or newline characters and converts the line to an integer.
- `numbers`: Used to calculate the average from the list of integers.
- `close()`: Closes the file to free up resources.