Q1.

(a) Explain the main differences between a batch processing system and a time sharing system.
Which is better in your opinion? Explain clearly.

(b) Explain in your own words how an operating system can be viewed mainly as a resource manager.
Identify the three most important resources in a computer system and explain briefly how an operating system manages these resources.

(c) Explain the difference between a program and a process.
What are the most important states of a process during its execution?
Explain clearly how a process goes from one state to another during its execution.

(d) What is the need for a process table?
What kind of information is stored in a process table entry?
How is a process table entry updated during process switching?

Q2.

(a) Discuss the differences between memory allocation through fixed partitions and dynamic partitions.
What are their relative advantages and disadvantages?

(b) What is the virtual memory of a computer system?
Explain how virtual memory can be larger than the physical memory of a system.
What is the difference between a logical address and a physical address?
Explain how a logical address is translated into a physical address in a system that uses paging.
(c) A hypothetical computer uses memory management through paging. Each address has 16 bits and out of these 16 bits, 4 bits are used for specifying page number and 12 bits are used for specifying offset within a page.

What is the total size of the main memory of this machine?

What is the size of a page frame?

How many pages can be in the main memory at a time?

What are the physical addresses corresponding to the following two logical addresses? (i) 0011000000001000 , (ii) 1000000000001110

You can write your answer in binary, or in plain English (e.g., address 78 in frame 7)

Some of the page table entries are given in the following table. Both the page numbers and frame numbers start from 0.

(Hint : The decimal equivalent of a binary number abcd is :
\[ d \times 2^0 + c \times 2^1 + b \times 2^2 + a \times 2^3 \])

<table>
<thead>
<tr>
<th>Page number</th>
<th>Frame number</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>15</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>9</td>
<td>6</td>
</tr>
<tr>
<td>12</td>
<td>12</td>
</tr>
</tbody>
</table>

(d) Explain what is meant by a page fault in a computer that uses the paging system for implementing virtual memory.

What are the actions taken by the operating system when a page fault occurs?

Is it always necessary to write the contents of an existing page to the disk before it can be replaced? Explain.
Q3.

(a) What is a system call? Explain why almost every process needs to execute at least one system call during its execution.

   Explain the fork() and execve() system calls in Unix systems.

   Why are these two system calls important for the command interpreter in Unix Shell?

   (5)

(b) Discuss the differences between static and dynamic linking of compiled modules. What are their relative advantages and disadvantages?

   (5)

(c) There are two types of processes in a hypothetical computer system. The first type is called CPU intensive since these processes do very little Input/Output but require considerable CPU time to complete execution. The second type is called I/O bound since these processes do a lot of Input/Output.

   Which type should be given higher priority for CPU scheduling for increasing the throughput of the system? Explain clearly.

   (4)

(d) Explain briefly how an operating system should enforce security for the following resources:

   • main memory of the system
   • file system

   (6)

END OF PAPER