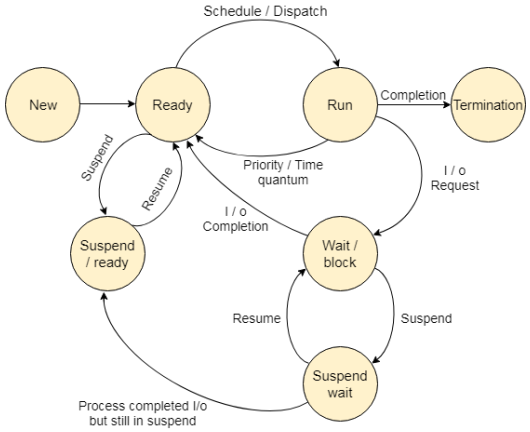
Q. No	Statement
	Section A 5 x 2 = 10 marks
1	What are the three main uses of OS? The operating system is used everywhere today, such as banks, schools, hospitals, companies, mobiles, etc. No device can operate without an operating system because it controls all the user's commands. • **LINUX/UNIX** operating system is used in the bank because it is a very secure operating system. • **Symbian OS, Windows Mobile, iOS, and Android OS** are used in mobile phone operating systems as these operating systems are a lightweight operating system. • **Features of Operating System** 1.Error detection and handling 2.Handling I/O operations 3.Virtual Memory Multitasking 4.Program Execution 5.Allows disk access and file systems
2	What is deadlock? A deadlock is a situation in which two computer programs sharing the same resource are effectively preventing each other from accessing the resource, resulting in both programs ceasing to function. **Deadlock can arise if** the **following four conditions hold simultaneously (Necessary Conditions)** ***Mutual Exclusion:*** Two or more resources are non-shareable (Only one process can use at a time) ***Hold and Wait:*** A process is holding at least one resource and waiting for resources. ***No Preemption:*** A resource cannot be taken from a process unless the process releases the resource. ***Circular Wait:*** A set of processes are waiting for each other in circular form.
3	What is segmentation? Segmentation divides processes into smaller subparts known as **modules**. The divided segments need not be placed in contiguous memory. Since there is no contiguous memory allocation, internal fragmentation does not take place. The length of the segments of the program and memory is decided by the purpose of the segment in the user program. We can say that logical address space or the main memory is a collection of segments.
4	What are the different types of networks? **Types of Network operating systems :** There are mainly two types of networks, one is peer to peer and another is client/server. Now let's see each type one by one. • **Peer to Peer –** Peer-to-peer network operating systems allow sharing resources and files with small-sized networks and having fewer resources. In general, peer-to-peer network operating systems are used on LAN. • **Client/server –** Client-server network operating systems provide users access to resources through the central server. This NOS is too expensive to implement and maintain. This operating system is good for the big networks which provide many services.
5	What is session hijacking? TCP session hijacking is a security attack on a user session over a protected network. The most common method of session hijacking is called IP spoofing, when an attacker uses source-routed IP packets to

	insert commands into an active communication between two nodes on a network and disguise itself as one of the authenticated users. This type of attack is possible because authentication typically is only done at the start of a TCP session. Another type of session hijacking is known as a man-in-the-middle attack, where the attacker, using a sniffer, can observe the communication between devices and collect the data that is transmitted. **Different ways of session hijacking :** 1.**Using Packet Sniffers** 2. **Cross Site Scripting(XSS Attack)**
Section B 4 x 5 = 20 marks	
6	a.) With the help of a neat diagram elaborate the concept of process and its states? The process, from its creation to completion, passes through various states. The minimum number of states is five. The names of the states are not standardized although the process may be in one of the following states during execution. **1. New** A program which is going to be picked up by the OS into the main memory is called a new process. **2. Ready** Whenever a process is created, it directly enters in the ready state, in which, it waits for the CPU to be assigned. The OS picks the new processes from the secondary memory and put all of them in the main memory. The processes which are ready for the execution and reside in the main memory are called ready state processes. There can be many processes present in the ready state. **3. Running** One of the processes from the ready state will be chosen by the OS depending upon the scheduling algorithm. Hence, if we have only one CPU in our system, the number of running processes for a particular time will always be one. If we have n processors in the system then we can have n processes running simultaneously. **4. Block or wait** From the Running state, a process can make the transition to the block or wait state depending upon the scheduling algorithm or the intrinsic behavior of the process. When a process waits for a certain resource to be assigned or for the input from the user then the OS move this process to the block or wait state and assigns the CPU to the other processes. **5. Completion or termination** When a process finishes its execution, it comes in the termination state. All the context of the process (Process Control Block) will also be deleted the process will be terminated by the Operating system. **6. Suspend ready** A process in the ready state, which is moved to secondary memory from the main memory due to lack of the resources (mainly primary memory) is called in the suspend ready state. If the main memory is full and a higher priority process comes for the

execution then the OS have to make the room for the process in the main memory by throwing the lower priority process out into the secondary memory. The suspend ready processes remain in the secondary memory until the main memory gets available.

7. Suspend wait

Instead of removing the process from the ready queue, it's better to remove the blocked process which is waiting for some resources in the main memory. Since it is already waiting for some resource to get available hence it is better if it waits in the secondary memory and make room for the higher priority process. These processes complete their execution once the main memory gets available and their wait is finished.



b.) Construct the Process Control Block along with its description in detail?The following are the data items −

Process State

This specifies the process state i.e. new, ready, running, waiting or terminated.

Process Number

This shows the number of the particular process.

Program Counter

This contains the address of the next instruction that needs to be executed in the process.

Registers

This specifies the registers that are used by the process. They may include accumulators, index registers, stack pointers, general purpose registers etc.

List of Open Files

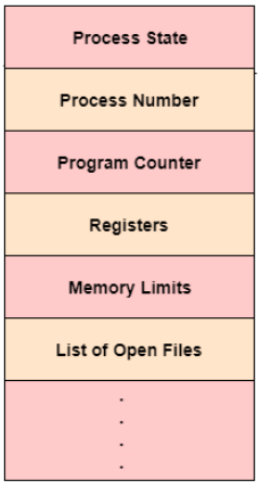
These are the different files that are associated with the process

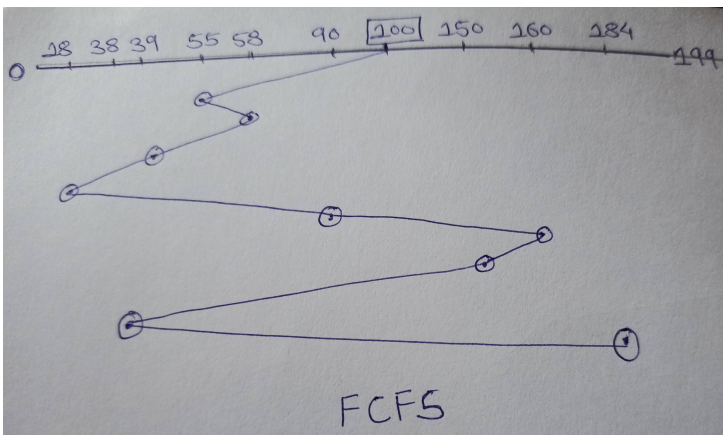
CPU Scheduling Information

The process priority, pointers to scheduling queues etc. is the CPU scheduling information that is contained in the PCB. This may also include any other scheduling parameters.

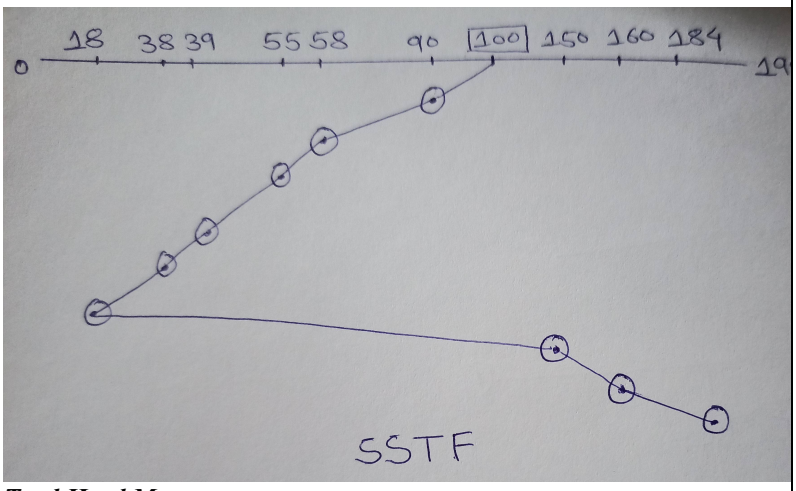
Memory Management Information

The memory management information includes the page tables or the

	segment tables depending on the memory system used. It also contains the value of the base registers, limit registers etc. **I/O Status Information** This information includes the list of I/O devices used by the process, the list of files etc. **Accounting information** The time limits, account numbers, amount of CPU used, process numbers etc. are all a part of the PCB accounting information. **Location of the Process Control Block** The process control block is kept in a memory area that is protected from the normal user access. This is done because it contains important process information. Some of the operating systems place the PCB at the beginning of the kernel stack for the process as it is a safe location.  Process Control Block (PCB)
7	Consider a disk with 200 tracks and the queue has random requests from different processes in the order: 55, 58, 39, 18, 90, 160, 150, 38, 184 Initially arm is at 100. Find the Average Seek length using FIFO, SSTF.



Total Head Movements
= (100 - 55) + (58 - 55) + (58 - 39) + (39 - 18) + (90 - 18) + (160 - 90) + (160 - 150) + (150 - 38) + (184 - 38)
= 45 + 3 + 19 + 21 + 72 + 70 + 10 + 112 + 146
= **498 Cylinders**
Average Seek Length = 498/9 = **55.34 ms**



Total Head Movements
= (100 - 90) + (90 - 58) + (58 - 55) + (55 - 39) + (39 - 38) + (38 - 18) + (150 - 18) + (160 - 150) + (184 - 160)
= 10 + 32 + 3 + 16 + 1 + 20 + 132 + 10 + 24
= **248 Cylinders**
Average Seek Length = 248/9 = **27.56 ms**

8 With suitable example differentiate between Network Operating System and Distributed Operating System.

S.NO	Network Operating System	Distributed Operating System
1.	Network Operating System's main objective is to provide the local services to remote client.	Distributed Operating System's main objective is to manage the hardware resources.
2.	In Network Operating System, Communication takes place on the basis of files.	In Distributed Operating System, Communication takes place on the basis of messages and shared memory.
3.	Network Operating System is more scalable than Distributed Operating System.	Distributed Operating System is less scalable than Network Operating System.
4.	In Network Operating System, fault tolerance is less.	While in Distributed Operating System, fault tolerance is high.
5.	Rate of autonomy in Network Operating System is high.	While The rate of autonomy in Distributed Operating System is less.

	6.	Ease of implementation in Network Operating System is also high.	While in Distributed Operating System Ease of implementation is less.
	7.	In Network Operating System, All nodes can have different operating system.	While in Distributed Operating System, All nodes have same operating system.

9 What is access matrix? Explain the implementation of access matrix

Access Matrix is a security model of protection state in computer system. It is represented as a matrix. Access matrix is used to define the rights of each process executing in the domain with respect to each object. The rows of matrix represent domains and columns represent objects. Each cell of matrix represents set of access rights which are given to the processes of domain means each entry(i, j) defines the set of operations that a process executing in domain Di can invoke on object Oj.

So we are going to discuss in brief about the above implementation. Its worth remembering that we are denoting subjects by **s** and objects by **O** and putting them on columns and rows respectively.

- **Capabilities:** This method refers to row wise decomposition of the access matrix. Each Subject is assigned with a list of tuples *(o, M[s, o])* for all objects o that it is allowed to access. This tuples are called Capabilities. If a subject possess a capability (o, M[s, o]) then it is allowed to access object o in the manner which is described in M[s, o]. A subject is allowed to access any objects for which it holds the capabilities.Capabilities are not meant to be forged. Capabilities contain two fields:

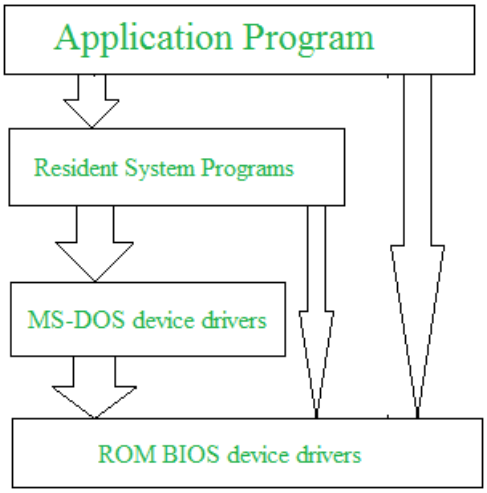
(i) Object Descriptor,
(ii) Access Rights

Object Descriptor may contain the address of the objects and Access Rights may contain the rights which the subject has on object, mainly read write, execute. Since object Descriptor contains address it may be used as an addressing mechanism also. Below is the format of capability.

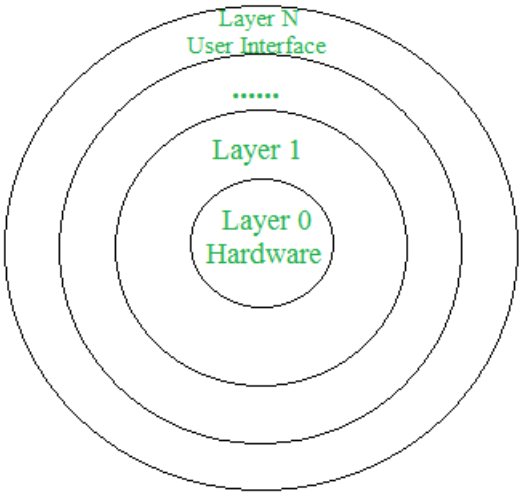
Capability Format

Object Descriptor	Rights of The Subject Read , Write , Execute

- **Access Control List:** This method refers to column wise decomposition of the access matrix . Each object o has a list containing tuples like *(s, M[s, o])* for all subjects s which can access the object.P[s, o] denotes the rights of the subject s on the object o. when a subject s request to access to the object o it is executed in the following manner.
- The system searches the access control list of o to find out if an entry (s,) exist for subject s
- If and entry (s,) exists for subject s then the system checks to see if the requested access is permitted or not.(i.e.,)
- If the requested access is permitted then the request is executed else an appropriate exception is raised.
-
- **Lock and key Method:** The lock and key method is an hybrid of the access control list and capabilities method. In the lock and key

	method, every subject has a capability list that contains tuples of the form (o, key), indicating the subject can access object o using key *key*. Objects has an access control list that contains tuples of the form (lock,), called a lock entry indicating lock *lock* can be accessed by modes in the set .
Section C 3 x 10 = 30 marks	
10	Enumerate the different operating system structure and explain with neat sketch Operating system can be implemented with the help of various structures. The structure of the OS depends mainly on how the various common components of the operating system are interconnected and melded into the kernel. Depending on this we have following structures of the operating system: **Simple structure:** Such operating systems do not have well defined structure and are small, simple and limited systems. The interfaces and levels of functionality are not well separated. MS-DOS is an example of such operating system. In MS-DOS application programs are able to access the basic I/O routines. These types of operating system cause the entire system to crash if one of the user programs fails. Diagram of the structure of MS-DOS is shown below.  **Advantages of Simple structure:** • It delivers better application performance because of the few interfaces between the application program and the hardware. • Easy for kernel developers to develop such an operating system. **Disadvantages of Simple structure:** • The structure is very complicated as no clear boundaries exists between modules. • It does not enforce data hiding in the operating system. **Layered structure:** An OS can be broken into pieces and retain much more control on system. In this structure the OS is broken into number of layers (levels). The bottom layer (layer 0) is the hardware and the topmost layer (layer N) is the user interface. These layers are so designed that each layer uses the functions of the lower level layers only. This simplifies the debugging process as if lower level layers are debugged and an error occurs during debugging then the error must be on that layer only as the lower level layers have already been debugged. The main disadvantage of this structure is that at each layer, the data needs to be modified and passed on which adds overhead to the system. Moreover careful planning of the layers is necessary as a layer can use

only lower level layers. UNIX is an example of this structure.



Advantages of Layered structure:

- Layering makes it easier to enhance the operating system as implementation of a layer can be changed easily without affecting the other layers.
- It is very easy to perform debugging and system verification.

Disadvantages of Layered structure:

- In this structure the application performance is degraded as compared to simple structure.
- It requires careful planning for designing the layers as higher layers use the functionalities of only the lower layers.

Micro-kernel:

This structure designs the operating system by removing all non-essential components from the kernel and implementing them as system and user programs. This result in a smaller kernel called the micro-kernel.

Advantages of this structure are that all new services need to be added to user space and does not require the kernel to be modified. Thus it is more secure and reliable as if a service fails then rest of the operating system remains untouched. Mac OS is an example of this type of OS.

Advantages of Micro-kernel structure:

- It makes the operating system portable to various platforms.
- As microkernels are small so these can be tested effectively.

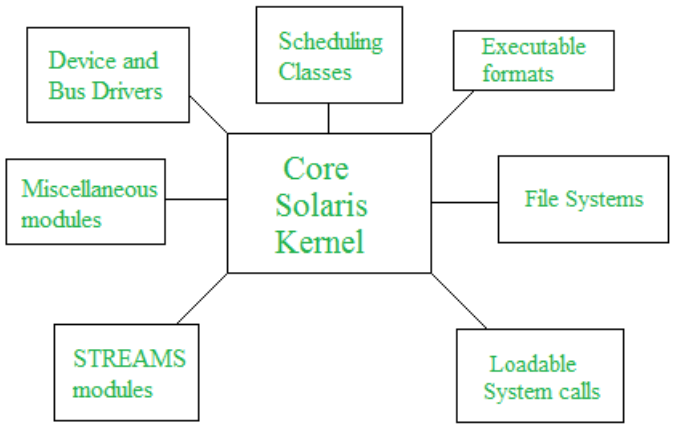
Disadvantages of Micro-kernel structure:

- Increased level of inter module communication degrades system performance.

Modular structure or approach:

It is considered as the best approach for an OS. It involves designing of a modular kernel. The kernel has only set of core components and other services are added as dynamically loadable modules to the kernel either during run time or boot time. It resembles layered structure due to the fact that each kernel has defined and protected interfaces but it is more flexible than the layered structure as a module can call any other module.

For example Solaris OS is organized as shown in the figure.



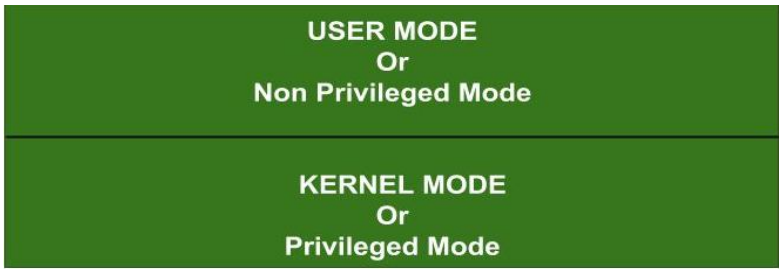
11

a.) Evaluating the maximum number of pages needed, if a system supports 16 bit address line and 1K page size.

A 16 bit address can address 2^16 bytes in a byte addressable machine. Since the size of a page 1K bytes (2^10),
the number of addressable pages is 2^16 / >2^10 = 2^6 = 64 pages.

b.) What is the difference between user-level instructions and privileged instructions?

In any Operating System, it is necessary to have a Dual Mode Operation to ensure the protection and security of the System from unauthorized or errant users. This Dual Mode separates the User Mode from the System Mode or Kernel Mode.



What are Privileged Instructions?

The Instructions that can run only in Kernel Mode are called Privileged Instructions .

Privileged Instructions possess the following characteristics :

(i) If any attempt is made to execute a Privileged Instruction in User Mode, then it will not be executed and treated as an illegal instruction. The Hardware traps it in the Operating System.

(ii) Before transferring the control to any User Program, it is the responsibility of the Operating System to ensure that the **Timer** is set to interrupt. Thus, if the timer interrupts then the Operating System regains the control.

Thus, any instruction which can modify the contents of the Timer is Privileged Instruction.

(iii) Privileged Instructions are used by the Operating System in order to achieve correct operation.

(iv) Various examples of Privileged Instructions include:

- I/O instructions and Halt instructions
- Turn off all Interrupts
- Set the Timer
- Context Switching
- Clear the Memory or Remove a process from the Memory

	• Modify entries in the Device-status table **What are Non-Privileged Instructions?** The Instructions that can run only in User Mode are called Non-Privileged Instructions . Various examples of Non-Privileged Instructions include: • Reading the status of Processor • Reading the System Time • Generate any Trap Instruction • Sending the final printout of Printer Also, it is important to note that in order to change the mode from Privileged to Non-Privileged, we require a Non-privileged Instruction that does not generate any interrupt.
12	What is encryption? Explain the working with the help of example Encryption secures digital data using one or more mathematical techniques known as cryptography. The information input becomes unreadable through encryption as an algorithm converts the original text, known as plaintext, into an alternative form known as ciphertext. When an authorized user needs to read the data, they may decrypt the data using a binary key or password. This will convert ciphertext back to plaintext so that the user can access the original information. Encryption is an important way for individuals and companies to protect sensitive information from hacking. For example, websites that transmit credit card and bank account numbers encrypt this information to prevent identity theft and fraud. **How does Encryption works?** Encryption strength depends on the length of the encryption security key. In the late 20th century, web developers used either 40-bit encryption, which is a key with 2^{40} possible permutations, or 56-bit encryption. By the end of the century, hackers successfully broke those keys, leading to a 128-bit system as the Advanced Encryption Standard (AES) encryption length for web browsers. Created in 2001 by the U.S. National Institute of Standards and Technology, key lengths of 128, 192, and 256 bits are available. Most banks, militaries, and governments use 256-bit encryption.1 **Types of Encryption** **Asymmetric Encryption** Asymmetric cryptography is used when increased security is the priority over speed and when identity verification is required. This type of encryption is used for digital signatures when signing an online document and in blockchain to authorize transactions for cryptocurrency. Asymmetric-key algorithms use different keys for the encryption and decryption processes. Types of asymmetric encryption include RSA and PKI. RSA is a popular algorithm used to encrypt data with a public key and decrypt it with a private key for secure data transmission. Public key infrastructure (PKI) governs encryption keys through the issuance and management of digital certificates.2

	Symmetric Encryption Symmetric encryption is used when speed is the priority over increased security and uses one secret symmetric key to both encrypt the plaintext and decrypt the ciphertext. This encryption is commonly used in credit card transactions. Types of symmetric encryption included Data Encryption Standards (DES), a low-level encryption block cipher algorithm that converts plain text into blocks of 64 bits and converts them to ciphertext using keys of 48 bits, and Advanced Encryption Standard (AES), the gold standard for data encryption and is used worldwide as the U.S. government standard