

Course Title – OPERATING SYSTEM

Course Code - 315319

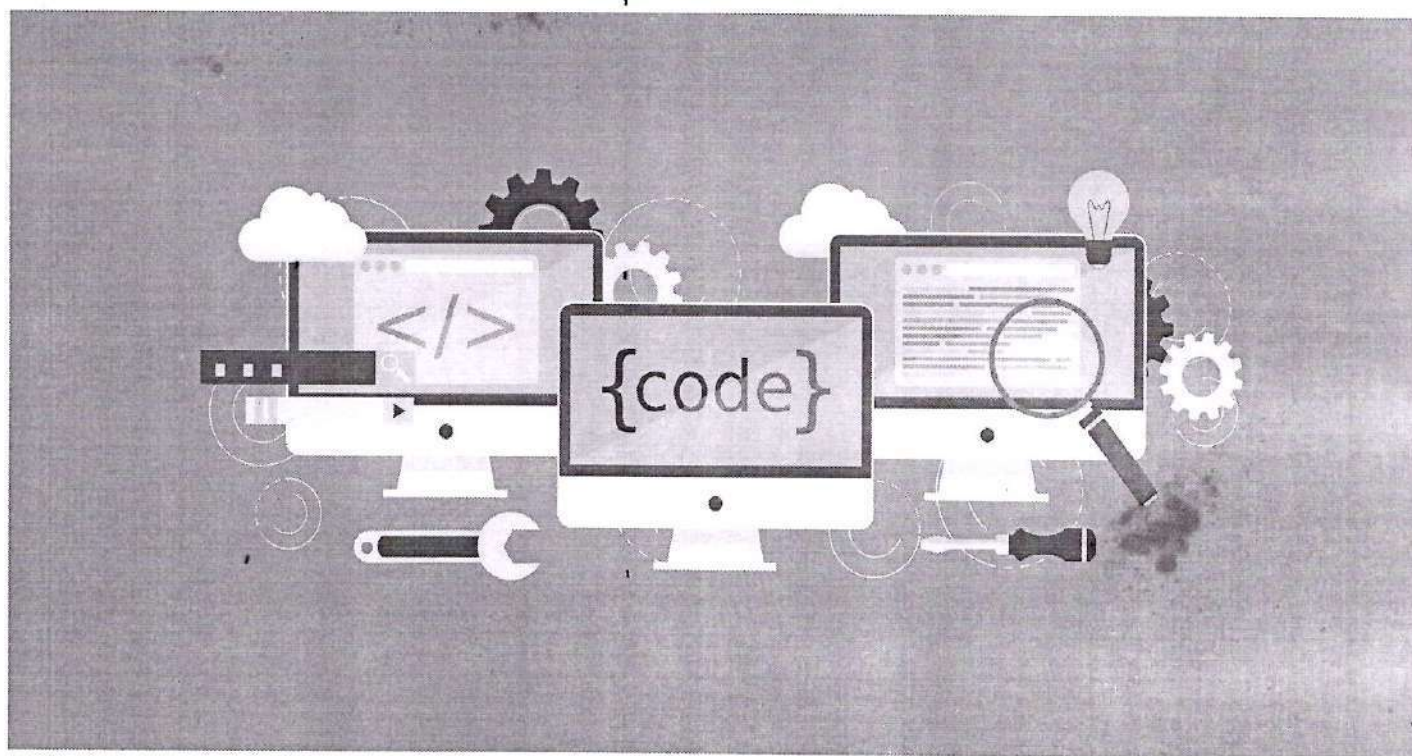
Programme Name - Computer Engineering

Semester - Fifth

Unit - I Operating System services and components

Total Marks:14

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1.1 Operating System :

Introduction to OS :

- An operating system act as a intermediary between the user of a computer systems & computer Hardware.
- The purpose of an OS is to provide an environment in which a user can executed program conveniently and efficiently.
- An OS is a program that act as an intermediary between a user of a computer & the computer Hardware.
- An OS is a computer program that manages the Computer resources like hardware & software of a Computer.

OS is also called as platform for the machine. If user would like to use readymade application or even if tries to use system development tools or languages. an OS should be present on the machine.

There are many important Functions performed by an OS like memory management, I/O management, CPU Job scheduling etc.

Major OS known worldwide are MS-DOS, Microsoft windows X, MAC, UNIX, Linux, sun solaris etc.



Subject: OPERATING SYSTEM (315319)
Unit - I Operating System services and components

Components of OS :

Computer system can be divided into four components

1. Hardware
2. Operating System
3. Application programs
4. Users

1. Hardware :

Hardware means the physical parts of computer system. These are the physical parts of machine which provide basic computing resources.

The major classifications of H/W devices is subsequent.

- a) Input devices: keyboard, Mouse, Microphone, Scanner, web camera etc.
- b) Output devices: printer, Monitor, speaker etc.
- c) Central processing unit (CPU)
- d) Storage Devices: Hard disk, Floppy disk, CD, DVD, pendrive
- e) Networking Devices: LAN card, Router, bridge, Hub, switch, modem.
- f) Other devices like: Motherboard, power supply, diff drives like DVD writer etc.

2. Operating System :

OS plays an important role here. It works like a coordinator between the computer hardware and user. Since it is system software, it can interact with H/W.

User uses different programs or applications called as software.



Subject: OPERATING SYSTEM (315319)
Unit - I Operating System services and components

3. Application program :

- They define the ways in which the system resources are used to solve the computing problem of the users.
- e.g. word processors, compilers, web browsers, databased system, video games etc.
- Application are readymade packages ready to use.
 - They utilize the hardware as well as software resources & fulfills user's computing requirement.

4. Users :

- There are many different users, trying to solve different problem. using different application programs.
- On basis of role of user, A user can be
- 1) Programmer : Is a users who developed, designed a slw.
 - 2) Operational Users : Is a user who is responsible for installation of slw, maintenance of slw.
 - 3) End users : Is a actual user of the application & performed specific task.

Functions of an Operating System :

Os is responsible for many important functions carried out for smooth functioning of a computer system. Following list demonstrates os functions.

- 1) Transferring input from input devices to memory.
- 2) Transferring input from memory to CPU.



Subject: OPERATING SYSTEM (315319)
Unit - I Operating System services and components

- 3) Shifting processed data from CPU to output devices.
- 4) Show msg on the screen in case of input as well as output.
- 5) Control input and output devices.
- 6) Loading of application programs from storage devices into main memory.
- 7) Copy or move data from one storage device to other.
- 8) Execution of programs and user instructions.
- 9) Protection of storage devices from overwriting.
- 10) Maintain details of files or directories with their respective details.
- 11) To provide security to user's data, programs & other files.

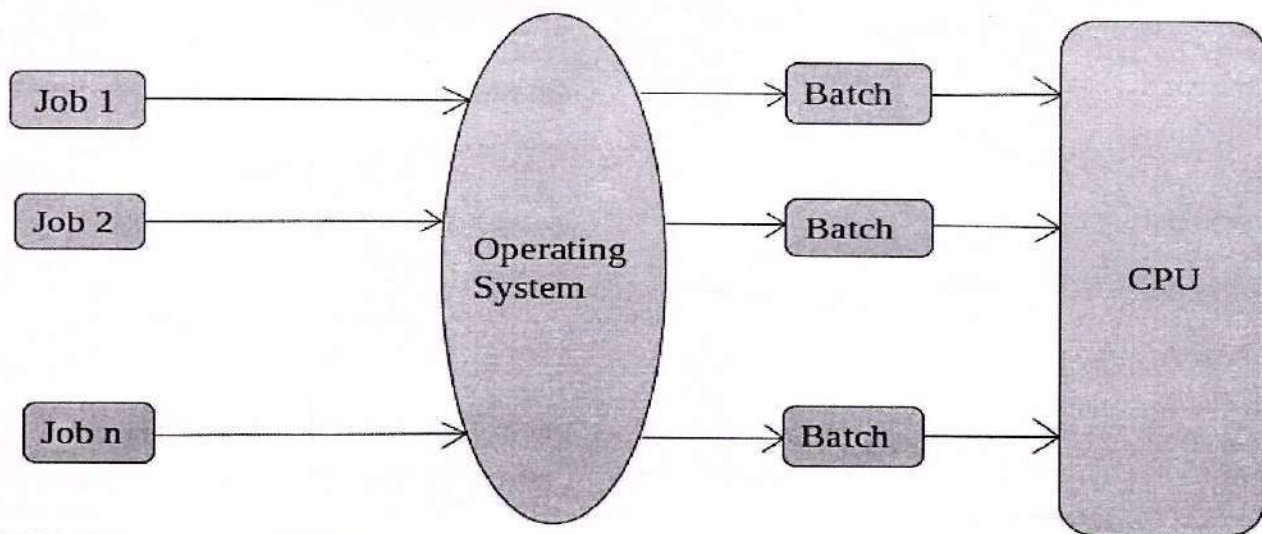
1.2 Different types of OS

1) Batch OS:

- This type of OS does not interact with the computer directly.
- There is an operator which takes similar jobs having the same requirement and groups them into batches.
- It is the responsibility of the operator to sort jobs with similar needs.
- Batch OS is designed to manage & execute a large number of jobs efficiently by processing them in groups.



Subject: OPERATING SYSTEM (315319)
Unit - I Operating System services and components



Advantages of Batch OS:

- 1) Multiple users can share the batch systems.
- 2) The idle time for the batch system is very little.
- 3) It is easy to manage large work repeatedly in batch system.

Disadvantages of Batch OS:

- 1) CPU is not used efficiently. When the current process is doing IO, the CPU is free & could be utilized by other processes waiting.
- 2) The other jobs will have to wait for an unknown time if any job fails.
- 3) In a batch OS, average response time increases as all processes are processed one by one.



2. Multi-Programming OS :

- Multiprogramming OS can be simply illustrated as more than one program is present in the main memory and any one of them can be kept in execution.
- This is used for better utilization of resources.
- Multiprogramming OS is an ability of an operating system, that executes more than one program using a single processor machine.

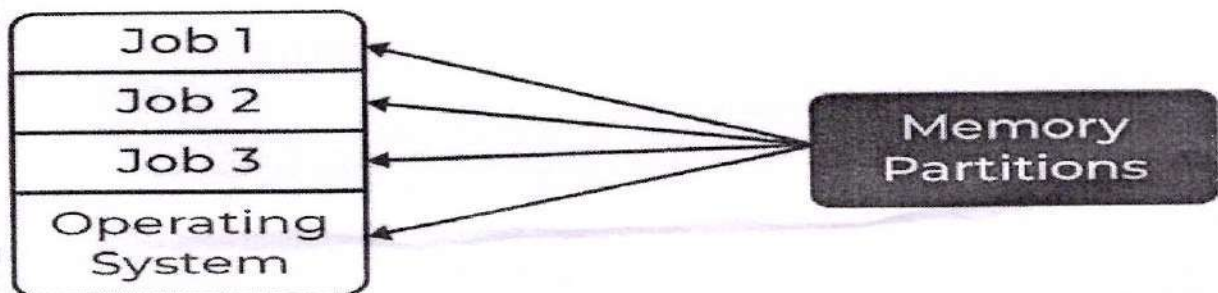
Advantages :

- 1) CPU utilization is high because the CPU is never goes to idle state.
- 2) Memory utilization is efficient.

Disadvantages :

- 1) CPU scheduling is compulsory because lots of jobs are ready to run on CPU simultaneously.
- 2) User is not able to interact with jobs when it is executing.
- 3) Programmers also cannot modify a program that is being executed.

Multiprogramming





3. Time-sharing OS / Multitasking OS :

- It is a type of multiprogramming system with every process running in round robin manner.
- Each task is given some time to execute so that all the tasks work smoothly.
- Each user gets the time of the CPU as they use a single system. These systems are also known as multitasking system.
- The task can be from a single user or different users.
- The time that each task gets to execute is called quantum. After this time interval is over, the OS switches over the next tasks.

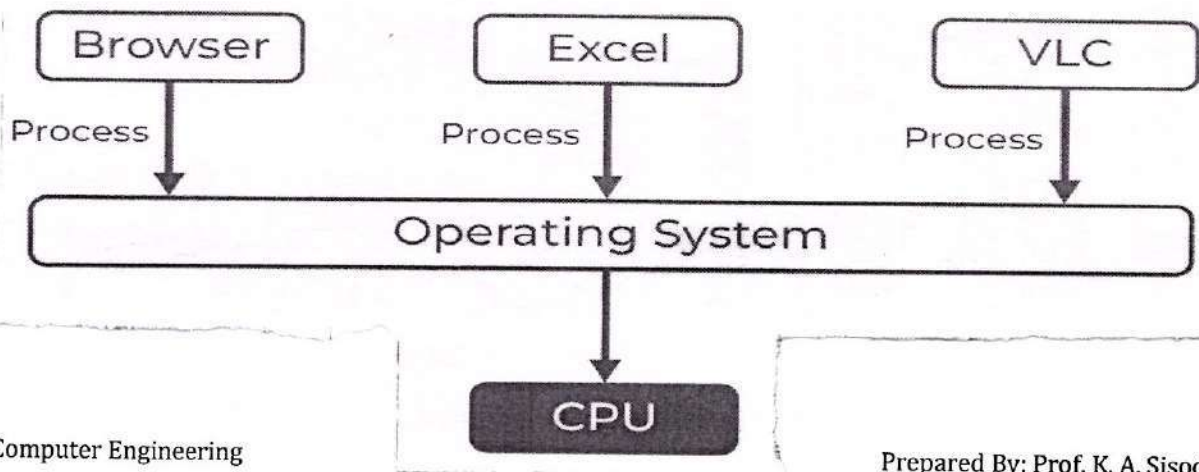
Advantages :

- 1) It provides the advantage of quick response.
- 2) It reduces CPU idle time.

Disadvantages :

- 1) Time sharing has problem of reliability.
- 2) Problem of data communication occurs.

Multitasking





4. Multi-Processing OS:

A multiprocessing OS is a type of OS in which more than one CPU is used for the execution of resources. It better the throughput of the system.

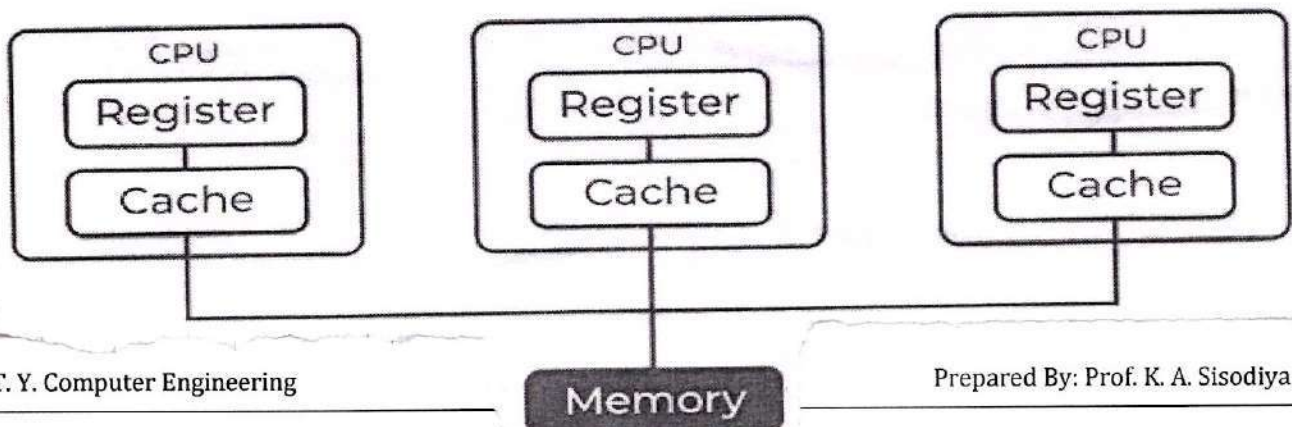
Advantages:

- 1) It increases the throughput of the system as processes can be parallelized.
- 2) As it has several processors, so if one processor fails, we can proceed with another processor.

Working of Multi-Processing OS:

- The system consist of multiple CPUs connected to a shared main memory.
- The OS divides the workload into smaller tasks or processes.
- These tasks are scheduled & distributed among available processors.
- Each processor executes its assigned task in parallel with other.
- After execution, results are combined to produce the final output.
- The OS manages CPU scheduling, memory access, & resource allocations, ensuring efficient utilization & synchronization.

Multiprocessing



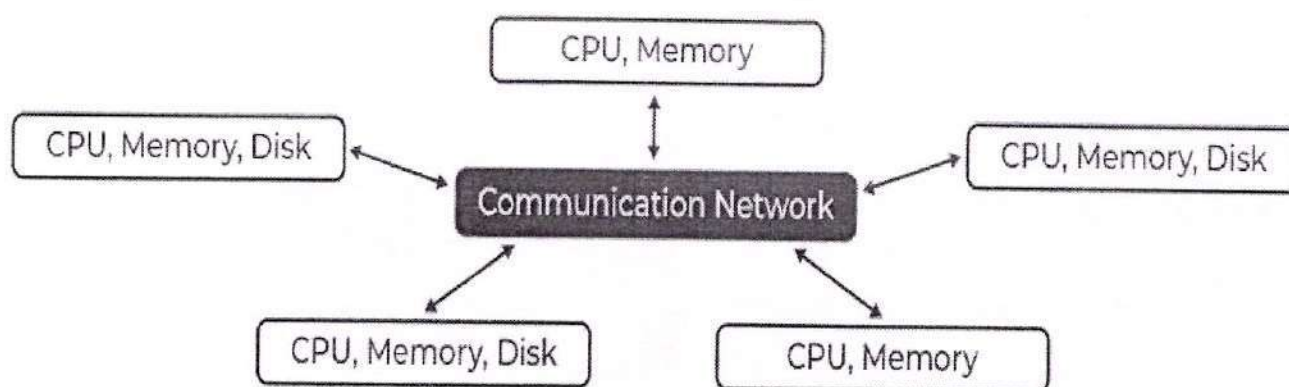


Subject: OPERATING SYSTEM (315319)
Unit - I Operating System services and components

5). Distributed OS :

- These type of OS are a recent advancement in the world of computer technology and are being widely accepted all over the world and that too, at a great pace.
- Various autonomous interconnected computers communicate with each other using a shared communication network.
- Independent systems possess their own memory unit and CPU system.
- These system processors differ in size and function.
- The major benefit of working with these types of operating system is that it is always possible that one user can access the files or software which are not present on his system but on some other system connected within this network.
i.e. remote access is enabled within the devices connected to that network.

Architecture of Distributed OS



6. Real-Time OS :

A Real-time OS is designed to handle time-sensitive tasks that must be completed within a fixed timeframe. These OS are used in environment where timing of immediate response are critical.

Characteristics :

- Executes tasks within strict time constraints.
- Prioritizes tasks based on urgency and importance.
- Ensure reliability and predictability for real-time application.

Types of RTOS :

- Hard Real-Time system : Guarantee completion of tasks within a predefined deadline.

Example : Air traffic control systems.

- Soft Real-time system : Allow minor deviations from deadlines.

Example : Streaming services or online gaming.

Applications :

- Medical devices (e.g. pacemakers)
- Automotive systems (e.g. anti-lock braking systems)

7. Mobile OS :

Mobile OS systems are optimized for mobile devices, such as smartphones and tablets, and are designed for portability and battery efficiency while supporting a range of applications.

Characteristics :

- Optimized for touchscreen interfaces, providing smooth user interface / interaction.
- Balanced performance and battery efficiency for long lasting use on mobile devices.



Subject: OPERATING SYSTEM (315319)
Unit - I Operating System services and components

Examples :

- Android, the most widely used mobile OS.
- iOS, Apple's operating system for iPhones and iPads.

Applications :

- Running mobile applications, games, & navigation systems.
- Managing calls, messages, & media on mobile devices.

1.3 Command Line based OS :

- i) DOS
- ii) UNIX

i) DOS - Disk Operating System :

1. It used Command Line interface to interact with the user.
2. Single user operating system.
3. Everything can be executed with commands only.
4. It has simple directory & file structure.
5. This does not provide GUI facility.
6. Mainly used on IBM machines.
7. Does not need huge amount of memory.
8. Multiprocessing & Multithreading is difficult.

ii) UNIX

1. It is a multiuser & powerful OS.
2. Interface is command line to interact with users.
3. Most of the UNIX commands are difficult to remember with its options.
4. Security and protection provided by OS is reasonable.



Subject: OPERATING SYSTEM (315319)
Unit - I Operating System services and components

GUI based OS : i) WINDOWS
ii) LINUX
iii) Mac OS

i) **WINDOWS** : windows versions have got following features:

- User friendly
- Multitasking & Multiprogramming
- Online compatibility
- High GUI Interface
- Plug & play technology
- high security
- Stand alone & Multiuser features
- Easy updations in program

ii) **LINUX** :

- open source software
- Highly secured OS.
- strong kernel program
- High security in multiuser environment
- cost effective
- Highly secured and protected OS.
- Highly portable
- Efficient and effective File system
- patches of code are added by experts from the different corners of the world.



Subject: OPERATING SYSTEM (315319)
Unit - I Operating System services and components

iii) Mac OS:

- macOS that Apple Inc. developed especially for its Macintosh computer series. It is the replacement for the classic MacOS.
- The reliability, security features, ease of use, and compatibility with other Apple goods and services are all well known aspects of macOS.
- It includes a number of built-in programs for a variety of functions, productivity, email, multimedia playing & web browsing.

1.4 Different Services of OS:

An OS provides services to both the users and to the programs

- It provides programs an environment to execute.
- It provides users the services to execute the program in a convenient manner.

Following are a few common services provided by an OS:

- program execution
- I/O operations
- File system manipulation
- Communication
- Error detection
- Resource allocation
- protection.



System calls concept:

The interface between a process and an OS is provided by system calls. In general, system calls are available as assembly language instructions.

They are also included in the manuals used by the assembly level programmers. System calls are usually made when a process in kernel to provide the resource via a system call.

A fig representing the execution of the system call is given as follows.

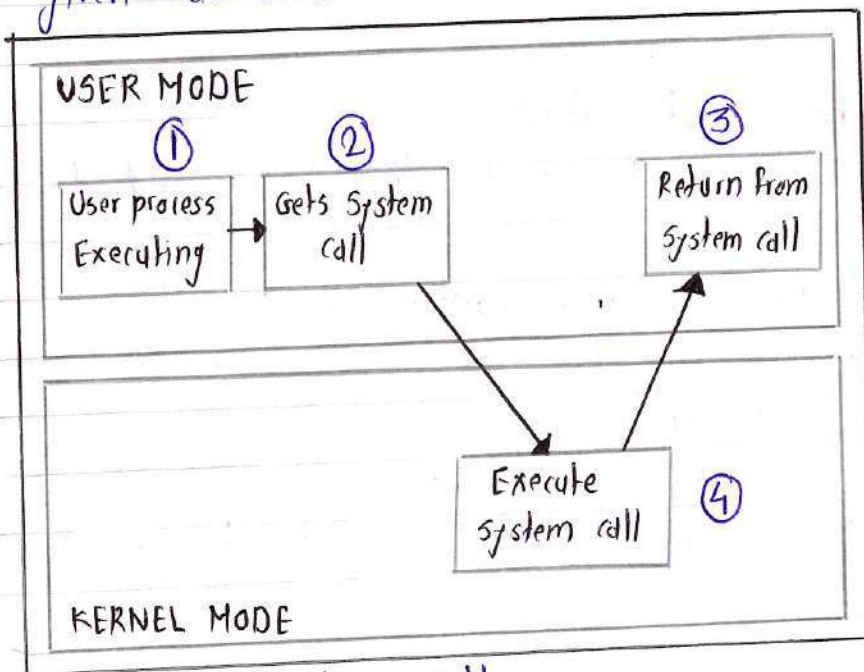


Fig: System call

As can be seen from this diagram, the processes execute normally in the user mode until a system call interrupts this. Then the system call is executed on a priority basis in the kernel mode. After the execution of the system call, the control returns to the user mode and execution of user processes can be resumed.



Subject: OPERATING SYSTEM (315319)
Unit - I Operating System services and components

Types of System call :

- process control
- File management
- Device Management
- Information Maintenance
- Communication

- process control: These system calls deal with processes such as process creation, process termination etc.
- File Management: These system call are responsible for File manipulation such as creating a file, reading a file, writing into a file etc.
- Device Management: These system call are responsible for device manipulation such as reading from device buffers, writing into device buffers etc.
- Information Maintenance:
This system call handle information and its transfer between the operating system and the user program.
- Communication :
These system call are useful for interprocess communication. They also deal with creating & deleting a communication connection.

Category	Windows System Call	Linux System Call	Purpose/Function
Process Control	CreateProcess()	fork()	Creates a new process.
	ExitProcess()	exit()	Terminates the current process.
	WaitForSingleObject()	wait()	Waits for a child process to terminate.
File Manipulation	CreateFile()	creat()	Creates or opens a file.
	ReadFile()	read()	Reads data from a file.
	WriteFile()	write()	Writes data to a file.
	CloseHandle()	close()	Closes an open file or handle.
Device Manipulation	SetConsoleMode()	ioctl()	Controls device parameters.
	ReadConsole()	read()	Reads input from the console/device.
	WriteConsole()	write()	Writes output to the console/device.
Information Maintenance	GetCurrentProcessId()	getpid()	Returns the current process ID.
	SetTimer()	alarm()	Sets a timer to send a signal after a specified time.
	Sleep()	sleep()	Suspends process execution for a specified time.
Communication	CreatePipe()	pipe()	Creates a pipe for inter-process communication (IPC).
	CreateFileMapping()	shmget()	Creates or allocates a shared memory segment.
	MapViewOfFile()	mmap()	Maps a file or device into memory.



1.5 Operating System Components :

1. Process Management :

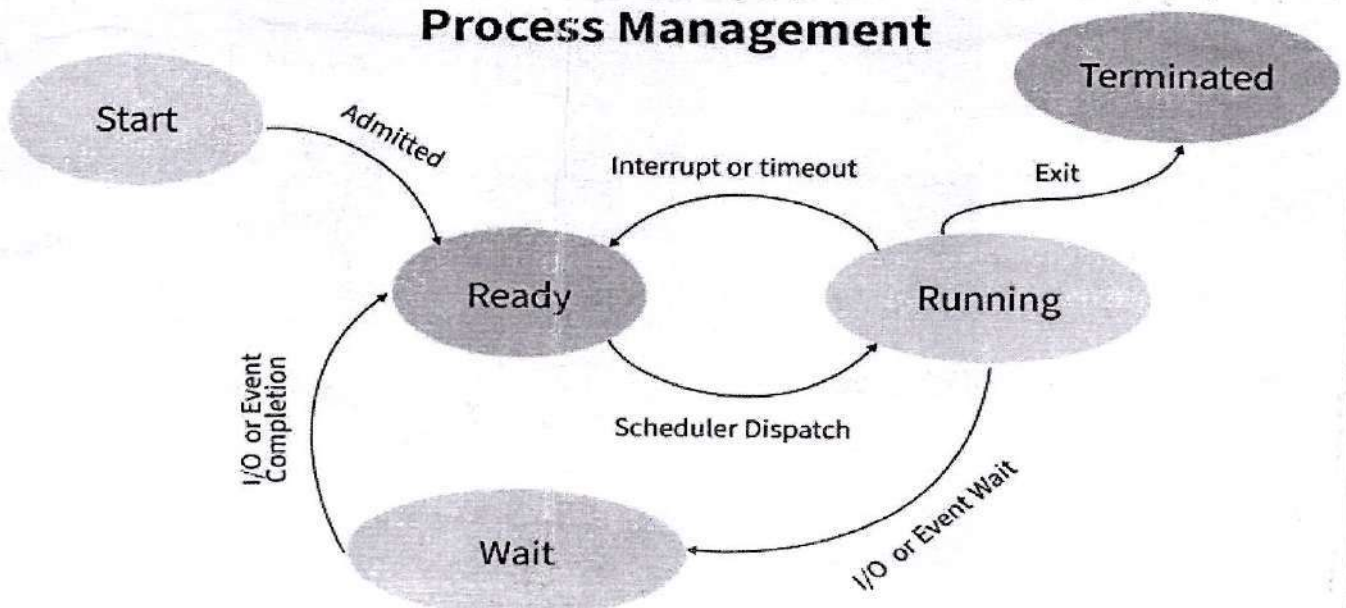
- process management in OS is about managing processes. A process is a running program.
- The Life cycle of process is from the moment program start until it finishes.

Operating system makes sure each process:

- gets its turn to use the CPU
- synchronized when needed
- has access to the resources it needs, like memory, files and input/output devices.

It also handles issues like process coordination and communication, while preventing conflicts such as deadlocks. This way, the OS ensures smooth multitasking and efficient resource use.

Process Management



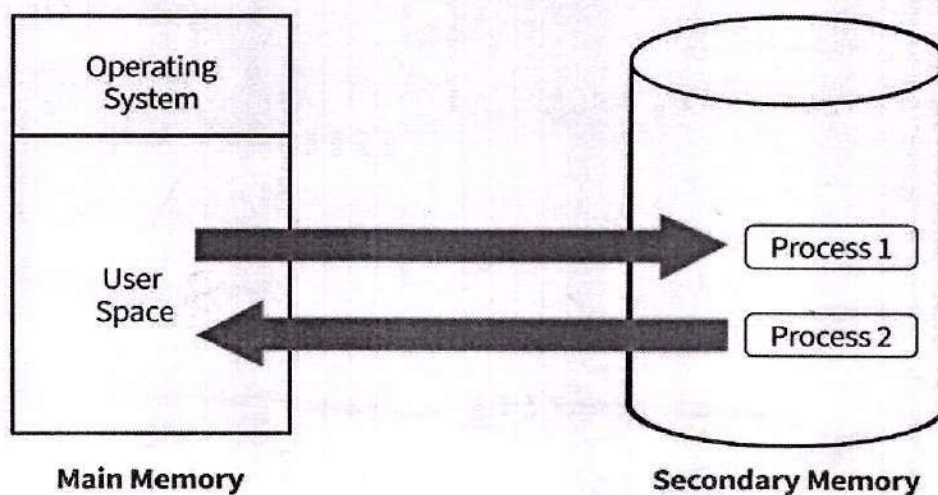
2. Memory Management :

Memory management is an essential task of the OS that handles the storage and organization of data in both main (primary) memory and secondary storage.

The OS ensures that memory is allocated and deallocated properly to keep programs running smoothly.

It also manages the interaction between volatile main memory and non-volatile secondary storage.

Memory Management



Main memory Management

- **Memory Allocation** : Assigns memory to processes using techniques like paging and segmentation.
- **Memory Deallocation** : Frees memory when no longer needed.
- **Memory Protection** : Prevents processes from accessing each other's memory.
- **Virtual Memory** : Uses disk space as extra memory to run larger processes.



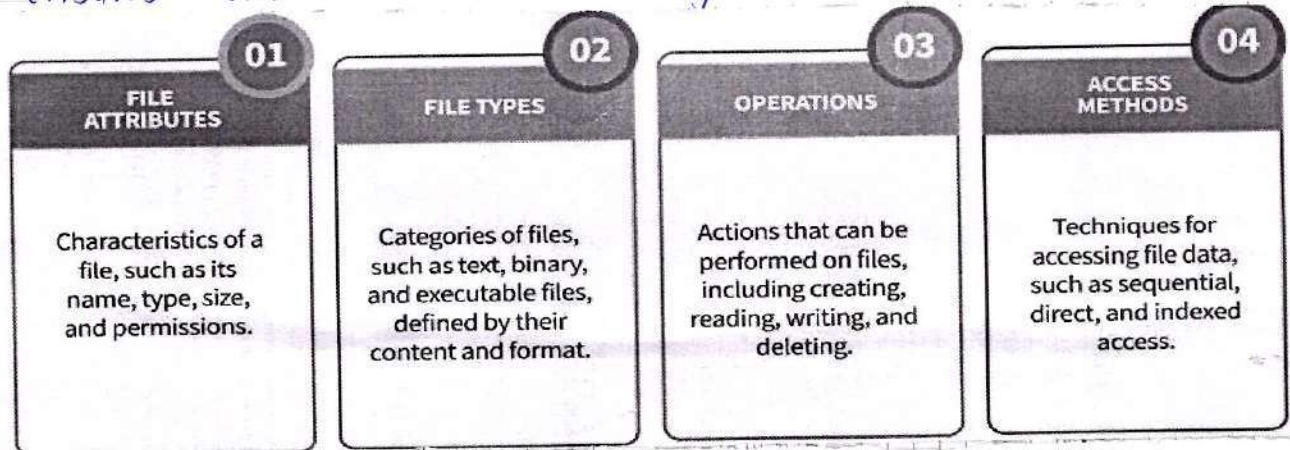
Subject: OPERATING SYSTEM (315319)
Unit - I Operating System services and components

Secondary Memory Management :

- Disk space Allocation : Organizes how files are stored on the disk (contiguous, linked, indexed).
- File system Management : Manages files & directories for efficient data access.
- File Space Management : Manages file & directories for efficient data access.
- Free space Management : Tracks available space on the disks.
- Disk scheduling : Organizes the order of disk read/write requests.
- Backup and Recovery : Ensures data is backed up and can be restored after failure.

3. File System Management :

- File management is the operating system ensures the organized storage access and control of files.
- The OS abstracts the physical storage details to present a logical view of files, making it easier for users to work with data.
- It manages how files are stored on different types of storage devices (like hard drives or SSDs) and ensures smooth access through directories and permissions.

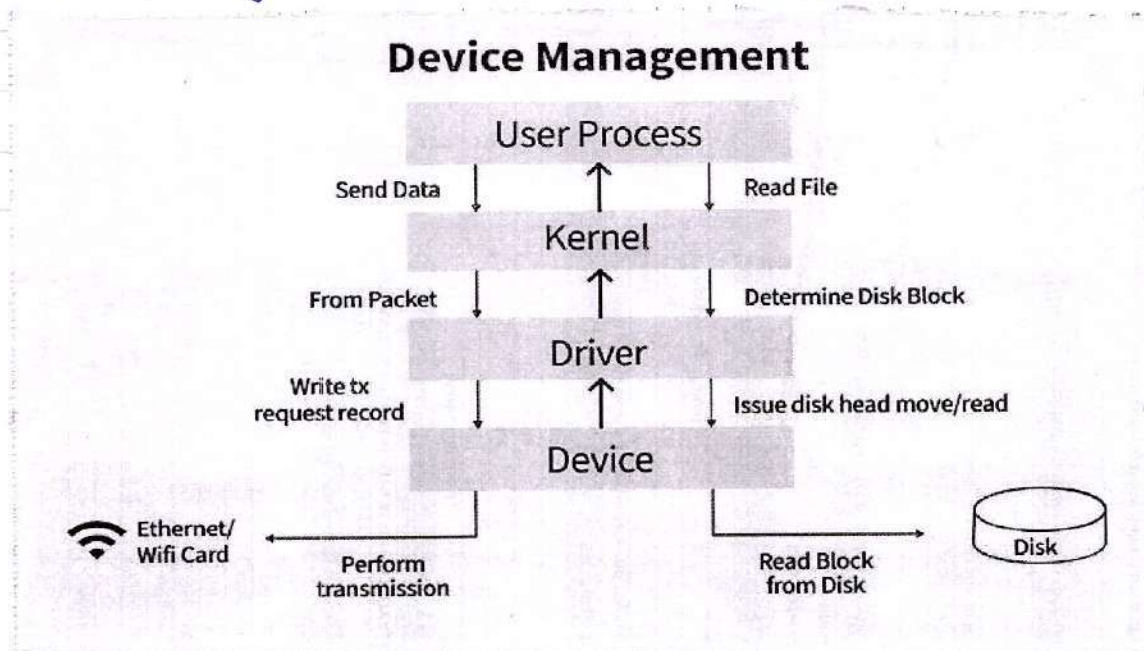




Subject: OPERATING SYSTEM (315319)
Unit - I Operating System services and components

4. I/O Management:

- Device management of an OS handles the communication between the system and its hardware devices, like printers, disks or network interfaces.
- The OS provides device drivers to control these devices, using techniques like direct Memory Access (DMA) for efficient data transfer and strategies like buffering and spooling to ensure smooth operation.



Major components is Device Management

Device Drivers: The OS uses device drivers to interact with hardware devices.

There are two types of Device drivers:

- kernel- space drivers run in the OS kernel, offering direct access to hardware.
- User-space drivers run outside the kernel and are more isolated, providing safety but less performance.



Subject: OPERATING SYSTEM (315319)
Unit - I Operating System services and components

File System Management includes managing of :

File Attributes :

- File Name: Identifies the file with a name & extension
(e.g., .txt, .jpg)
- File Type: Defines the format of the file (e.g., .text, image)
- Size: The amount of storage the file occupies
- Permission: Determines who can read, write, or execute the file.

File Types :

- Text Files: Contain human-readable content (e.g., .txt, .md).
- Binary Files: Store data in binary format (e.g., .jpg, .mp3)
- Executable Files: Contain program code (e.g., .exe, .out)

Operations on Files

- Create: Allows users to create new files.
- Read: Opens files to read their contents.
- Write: Modifies the contents of a file.
- Delete: Removes a file from the system.

Access Methods

- Sequential Access: Reads data in order, from start to finish.
- Direct Access: Jumps to a specific part of the file.
- Indexed Access: Uses an index for quick data retrieval.



Subject: OPERATING SYSTEM (315319)
Unit - I Operating System services and components

Buffering & Caching :

- Buffering temporarily stores data in memory to manage differences in device speeds. Block devices (e.g. hard drives) use larger blocks of data for buffering, while character devices (e.g. keyboard, mice) use smaller, byte-by-byte buffering.
- Caching improves access speed by storing frequently accessed data in a faster storage medium (like RAM).

Spooling :

Spooling manages data waiting to be processed, particularly in devices like printer. The OS places print jobs in a spool, allowing the CPU to continue other tasks while the printer works through the queue.

Other examples include mail spooling (for managing outgoing email) and batch-job spooling (for managing scheduled tasks.)



5. Secondary Storage Management

- The main purpose of computer system is to execute programs. These programs, together with the data they access, must be in main memory during execution. Since the main memory is too small to permanently accommodate all data and program, the computer system must provide secondary storage to backup main memory.
- Most modern computer systems use disks as the principle on-line storage medium, for both programs & data.
- Most programs, like compilers, assemblers, sort routines, editors, formatters, & so on, are stored on the disk until loaded into memory, and then use the disk as both the source and destination of their processing.

The operating system is responsible for the following activities in connection with disk management:

- Free space management
- Storage allocation
- Disk scheduling.

2-MARKS

- 1.State any two command line based operating systems (1.2-R) and two GUI based operating system.
- 2.Define system call and enlist its types. (CO1-1.3-R)
- 3.List different types of operating system. (CO1-1.1-R)
- 4.State any four services provided by an operating system. (CO1-1.4-R)
- 5.Define real time operating system, along with any two applications of it. (CO-1.1-R)
- 6.State any four operating system services. (CO1-1.2.R)
- 7.Differences between Linux and windows. (CO1-1.2.R)

4-MARKS

- 1.Explain real time system. List any two applications (CO1-1.2-U)
- 2.What is operating system ? Explain following types of operating system with suitable example of each. (CO1-1.1-U)
 - i)Distributed OS
 - ii) Mobile OS
- 3.Compare between Time sharing operating system and multiprogramming operating system.
- 4.Explain any four types of system call. (CO1-1.3.U)
- 5.Describe multiprocessor OS with it's advantages. (any two) (CO-1.1-U)
- 6.Explain different components of operating system. (CO-1.4-U)
- 7.Explain different Services of operating system. (CO1-1.3-U)
- 8.Explain Batch operating system. (CO1-1.1-U)
- 9.Explain Command line based OS
 - i)DOS
 - ii)UNIX
- 10.Explain Function of operating system. (CO1-1.4.U)