

CS2254 – OPERATING SYSTEMS QUESTION BANK

UNIT-I

1. What is an operating system?

An operating system is a program that manages the computer hardware. It also provides the basis for application programs and act as an intermediary Between a user of computer and the computer hardware. Some of the available operating systems are Microsoft's window, Macintosh, Ms-Dos.

2. What is the main purpose of an operating system?

- a) It provides the environment for executing the programs.
- b) The primary goal of an OS is the efficient use of computer systems which is otherwise called as resource utilization.

3. Define briefly about mainframe system.

Mainframe computer systems use the first computers used to tackle may commercial and scientific applications.

Initially mainframe systems were based on batch systems and now those systems are based on time-sharing systems.

4. Define batch systems.

Batch processing systems which service a collection of jobs, called a batch. They do this by sequentially reading the job into the machine and then executing the programs for each job in the batch. Once job is submitted to system, the user cannot interact with the program until they operate.

5. What is the advantage of Multiprogramming?

Multiprogramming increases CPU utilization by organizing jobs so that the CPU always has one to execute. Several jobs are placed in the main memory and the processor is switched from job to job as needed to keep Several jobs advancing while keeping the peripheral devices in use.

6. What is an Interactive computer system?

Interactive computer system provides direct communication between the user and the system. The user gives instructions to the operating system or to a program directly, using a keyboard or mouse ,and waits for immediate results.

7. What do you mean by Time-sharing systems?

Time-sharing or multitasking is a logical extension of multiprogramming. It allows many users to share the computer simultaneously. The CPU executes multiple jobs by switching among them, but the switches occur so frequently that the users can interact with each program while it is running.

8. Define time sharing system.

Time-sharing system is a logical extension of multiprogramming the cpu execute multiple jobs by switching among them, but the switches occur so frequently that the users can interact with each program while it is running. The OS that implements time-sharing uses short term scheduling and memory sharing to support multiple virtual machines.

9. What is desktop system? Define various criteria required by OS for Such systems?

Personal computers and other single user systems are known as desktop systems. The criteria used by the OS are

- The primary goal of OS is maximizing user convenience and responsiveness.
- They must provide environment for networking (exchanging of files from one system to another)

10. What are multiprocessor systems?

The system which consists of more than one processor are termed as multiprocessor systems. They are also known as parallel systems or tightly coupled systems.

11. Distinguish between symmetric and asymmetric multiprocessor systems

S.NO	Symmetric multiprocessor systems	Asymmetric multiprocessor systems
1	Here each processor runs an identical copy of the operating system and these copies communicate with one another as needed.	Here each processor is assigned a specific task. A master processor look to master processor for predefined instruction.
2	Symmetric multiprocessor systems means that all processor are peers and no master slave relationship exists between processor. Ex: Encore version of Unix for Multimax computer	It defines master slave relationship. The master processor schedules and allocates work to the slave processors. Ex:Sun OS version

12. Define graceful degradation and fault tolerance.

In multiprocessor systems the functions can be distributed properly among several processors, and then the failure of one processor will not halt the system and only slow it down. This ability to continue providing service proportionally to the level of surviving hardware is called graceful degradation. Systems designed for graceful degradation are also called fault tolerance.

13. What are loosely coupled systems?

The systems which consists of a collection of processors that do not share memory or a clock. Instead each processor has its own memory. The processors communicate with one through various communication lines such as high-speed buses or telephone lines. These systems are referred as loosely coupled systems.

14. Define network operating systems?

A network OS is a OS that provides features such as file sharing access across the network and includes communication scheme that allows different processes on different computers to exchange messages. A computer running a network OS acts autonomously from all other computer on the network and is able to communicate with other networked computers.

15. What are clustered systems?

A clustered system consists of two or more individual systems coupled together to accomplish computational work. Clustering is usually performed to provide high availability.

16. Define real-time systems?

Real-time systems are the special purpose OS which are used when rigid time requirements have been placed on the operation of a processor or the flow of data hence it is a well defined fixed time constraints.

17. Distinguish between hard real-time system and soft real-time system?

S.No	Hard real-time system	Soft real-time system
1	Hard real-time system has well defined, fixed time-constraints.	Soft real-time system have less stringent timing constraints.
2	Processing must be done within the defined constraints or the system will fail.	They do not support deadline scheduling.

18. What is a system calls?

System calls provide the interface between a process and the operating system. They are grouped roughly as

- Process control
- Information maintenance
- File management
- Communication
- Device management

19. What are kernels?

The part of system software executing in supervisor state is called the kernel of the OS. The kernel operates as trusted software meaning that when it is designed and implemented, it is intended to provide protection mechanism that could not be changed through the action of un trusted of software executing in user state. The most critical part of OS is encapsulation in the kernel.

20. What is virtual machine?

An OS creates the illusion that the process has its own processes with its own memory by sharing system resources and machine implementing this technique are called as virtual machines.

21. What is system program?

System programs provide a convenient environment for program development and execution. Some of them are simply user interfaces to system calls others are more complex. They are divided as file management, status information, file modification, processing language support, program load and execution and communication.

22. What is context switch?

The OS saves registers, internal variables, buffer and changes several other parameters to prepare for the next program to run. This process is known context switch.

23. List out various handheld system?

Handheld systems include personal digital assistants (PDAs), such as Palm Pilot or Cellular telephones with connectivity to a network such as the internet. It is useful because of its limited size.

24. What are two types of real time system?

Hard real time system: It guarantees that critical task be completed on time.

Soft real time system: It is a less restrictive type. Where a critical real time task gets priority over other task and retains that priority until it completes.

25. What are privileged instructions?

Some of the machine instructions that may cause harm to a system are designated as privileged instructions. The hardware allows the privileged instructions to be executed only in monitor mode

26. Define thread cancellation & target thread.

The thread cancellation is the task of terminating a thread before it has completed. A thread that is to be cancelled is often referred to as the target thread. For example, if multiple threads are concurrently searching through a database and one thread returns the result, the remaining threads might be cancelled.

UNIT II

1. Define process?

A process is more than a program code, which is sometime known as the text section. IT also includes the current activity, as represented by the value of the program counter and the processor's registers.

2. What is meant by the state of the process?

The state of the process is defined in part by the current activity of that process. Each process may be in one of the following states.

- New: The process is being created.
- Running: Instruction are being executed

- Waiting: The process is waiting for some event to occur.
- Ready: The process is waiting to be assigned to a processor
- Terminated: The process has finished execution

3. Define process control block contain?

Each process is represented in the operating system by a process control block (PCB) – also called as task control block. The PCB simply serves as the repository for any information that may vary from process to process

4. What does PCB contain?

- Process state
- Program counter
- CPU registers
- CPU scheduling information
- Memory management information
- Accounting information

5. What are the 3 different types of scheduling queues?

- Job Queue: As process enters the system they are put into job queue.
- Ready Queue: The process that are residing in the main memory and are ready and waiting to execute are kept in the queue
- Device Queue: The list of processes waiting for particular I/O device is called a device queue.

6. Define schedulers?

A process migrates between the various scheduling throughout its lifetime. The operating system must select, for scheduling purposes, processes from these queues in some fashion. The selection process is carried out by the appropriate scheduler.

7. What are the types of scheduler?

Long term scheduler or job scheduler selects processes from the pool and load them into the memory for execution.

Short term scheduler or CPU scheduler, select among the processes that are ready to execute and allocates the CPU to one of them.

8. Define critical section?

If a system consist on n processes { P₀, P₁, ..., P_{n-1} }. Each process has a segment of code called a critical section, in which the process may be changing common variables, updating a table, writing a file. The important features of this system is that, when one process is in its critical section, no other process is to be allowed to execute in its critical section.

9. What requirement is to be satisfied for a solution of a critical section problem?

A solution to the critical section problem must satisfy the following 3 requirements.

- Mutual exclusion: If process P₁ is executing in its critical section, then no other processes can be executing in their critical sections.

- Progress: If no process is executing in its critical section and some processes wish to enter their critical sections, then only those processes that are not executing in their remainder section can participate in the decision on which will enter its critical section next, and this selection cannot be postponed indefinitely.
- Bounded waiting: There exists a bound on the number of times that other processes are allowed to enter their critical section after a process has made a request to enter its critical section and before that request is granted.

10. Define semaphores.

Semaphore is a synchronization tool. A semaphore S is an integer variable that apart from initialization is accessed only through 2 standard atomic operations.

- Wait
- Signal

11. Define Starvation in deadlock?

A problem related to deadlock is indefinite blocking or starvation, a situation where processes wait indefinitely within a semaphore. Indefinite blocking may occur if we add and remove processes from the list associated with a semaphore in LIFO order.

12. Name some classic problem of synchronization?

- The Bounded – Buffer Problem
- The Reader – Writer Problem
- The Dining –Philosophers Problem

13. Define deadlock?

A process requests resources; if the resources are not available at that time, the process enters a wait state. Waiting processes may never change state, because the resources they are requested are held by other waiting processes. This situation is called deadlock.

14. What is the sequence of operation by which a process utilizes a resource?

Under the normal mode of operation, a process may utilize a resource in only the following sequence:

- Request: If the request cannot be granted immediately, then the requesting process must wait until it can acquire the resource.
- Use: The process can operate on the resource.
- Release: The process releases the resource

15. Give the condition necessary for a deadlock situation to arise?

A deadlock situation can arise if the following 4 conditions hold simultaneously in a system.

- Mutual Exclusion
- Hold and Wait
- No preemption
- Circular Wait

16. Define ‘Safe State’?

A state is safe if the system allocates resources to each process in some order and still avoid deadlock.

17. What is the use of cooperating processes?

- Information sharing: Since several users may be interested in the same piece of information, we must provide an environment to allow concurrent access to these type of resources.
- Computation speedup: If we want a particular task to run faster, we must break it into subtask, each of which executing in parallel with others.
- Modularity: We may want to construct the system in a modular fashion, dividing the system functions into separate processes or thread.
- Convenience: Even an individual user may have many tasks on which to work at one time. For instance a user is editing, printing and computing in parallel.

18. Define deadlock-avoidance algorithm?

A deadlock-avoidance algorithm dynamically examines the resource allocation state to ensure that a circular wait condition can never exist. The resource allocation state is defined by the number of available and allocated resources, and the maximum demand of the processes.

19. What are the benefits of multithreaded programming?

- Responsiveness
- Resource sharing
- Economy
- Utilization of multiprocessor architecture

20. Define deadlock detection diction?

If a system does not employ either a deadlock-prevention or a deadlock avoidance algorithm, then a deadlock situation may occur. In this environment, the system must provide:

- An algorithm that examines the state of the system to determine whether a deadlock has occurred
- An algorithm to recover from the deadlock.

21. Define race condition.

When several process access and manipulate same data concurrently, then the outcome of the execution depends on particular order in which the access takes place is called race condition. To avoid race condition, only one process at a time can manipulate the shared variable

22. What is critical section problem?

Consider a system consists of ‘n’ processes. Each process has segment of Code called a critical section, in which the process may be changing common variables, updating a table, writing a file. When one process is executing in its critical section, no other process can allowed to execute in its critical section.

23. Define busy waiting and spinlock.

When a process is in its critical section, any other process that tries to enter its critical section must loop continuously in the entry code. This is called as busy waiting and this type of semaphore is also called a spinlock, because the process while waiting for the lock.

24. What are the requirements that a solution to the critical section problem must satisfy?

The three requirements are

- ☐ Mutual exclusion
- ☐ Progress
- ☐ Bounded waiting

25. Define entry section and exit section.

The critical section problem is to design a protocol that the processes can use to cooperate. Each process must request permission to enter its critical section. The section of the code implementing this request is the entry section. The critical section is followed by an exit section. The remaining code is the remainder section.

26. What are conditions under which a deadlock situation may arise?

A deadlock situation can arise if the following four conditions hold

Simultaneously in a system:

- a. Mutual exclusion
- b. Hold and wait
- c. No pre-emption
- d. Circular wait

27. What is a resource-allocation graph?

Deadlocks can be described more precisely in terms of a directed graph called a system resource allocation graph. This graph consists of a set of vertices V and a set of edges E . The set of vertices V is partitioned into two different types of nodes; P the set consisting of all active processes in the system and R the set consisting of all resource types in the system.

UNIT-III**1) What is address binding?**

The process of mapping from one address space to another is as address binding. The types of addresses are:

- Physical address
- Symbolic address
- Relocatable address
- Absolute address

2) Define logical address and physical address.

An address generated by the CPU is referred as logical address. An address seen by the memory unit that is the one loaded into the memory address register of the memory is commonly referred to as physical address.

3) What is logical address space and physical address space?

The set of all logical addresses generated by a program is called a logical address space; the set of all physical addresses corresponding to these logical addresses is a physical address space.

4) What is the main function of the memory-management unit?

The runtime mapping from virtual to physical addresses is done by a hardware device called a memory management unit (MMU).

5) Define dynamic loading.

To obtain better memory-space utilization dynamic loading is used. With dynamic loading, a routine is not loaded until it is called. All routines are kept on disk in a relocatable load format. The main program is loaded into memory and executed. If the routine needs another routine, the calling routine checks whether the routine has been loaded. If not, the relocatable linking loader is called to load the desired program into memory.

6). Define dynamic linking.

Dynamic linking is similar to dynamic loading, rather than loading being postponed until execution time, linking is postponed. This feature is usually library routine, or how to load the library if the routine is not already present.

7). what are overlays?

To enable a process to be larger than the amount of memory allocated to it, overlays are used. The idea of overlays is to keep in memory only those instructions and data that are needed at a given time. When other instructions are needed, they are loaded into space occupied previously by instructions that are no longer needed.

8) Define swapping.

A process needs to be in memory to be executed. However a process can be swapped temporarily out of memory to a backing store and then brought back into memory for continued execution. This process is called swapping.

9) What are the common strategies to select a free hole from a set of available holes?

The most common strategies are
a. First fit b. Best fit c. Worst fit

10). What do you mean by best fit?

Best fit allocates the smallest hole that is big enough. The entire list has to be searched, unless it is sorted by size. This strategy produces the smallest leftover hole.

11). What do you mean by first fit?

First fit allocates the first hole that is big enough. Searching can either start at the beginning of the set of holes or where the previous first-fit search ended. Searching can be stopped as soon as a free hole that is big enough is found.

12) What is external fragmentation?

When the processes are loaded and removed from memory, the free space is broken in to little pieces called fragments, This exists when enough total memory space exists to satisfy a request, but it is not contiguous.

13) What is Internal fragmentation?

Generally the physical memory is broken in to fixed size blocks and allocated memory in unit of block sizes. The memory allocated to a process may be slightly larger than the requested memory. The difference between these two is internal fragmentation.

14) What is demand paging?

Demand paging is similar to a system with swapping. Processes reside on secondary memory. When we want to execute a process, we swap it in to memory. Rather than swapping entire process into memory we use a lazy swapper. A lazy swapper never swaps a page into memory unless the page will be needed.

15) What is called memory mapping?

Every time the file is accessed requires a system call and disk access. Alternatively, we can use the virtual-memory techniques discussed so far to treat file I/O as routine memory access. This approach is known as memory mapping.

UNIT-4

1). What is virtual memory?

Virtual memory is a technique that allows the execution of processes that may not be completely in memory. It is the separation of user logical memory from physical memory. This separation provides an extremely large virtual memory, when only a smaller physical memory is available.

2). What is Demand paging?

Virtual memory is commonly implemented by demand paging. In demand paging, the pager brings only those necessary pages into memory instead of swapping in a whole process. Thus it avoids reading into memory pages that will not be used anyway, decreasing the swap time and the amount of physical memory needed.

3). Define lazy swapper.

Swapper is used. A lazy swapper never swaps a page into memory unless that page will be needed.

4). What is a pure demand paging?

When starting execution of a process with no pages in memory, the operating system sets the instruction pointer to the first instruction of the process, which is on a non-memory resident page, the process immediately faults for the page. After this page is brought into memory, the process continues to execute, faulting as necessary until every page that it needs is in memory. At that point, it can execute with no more faults. This schema is pure demand paging.

5). Define effective access time.

Let p be the probability of a page fault ($0 \leq p \leq 1$). The value of p is expected to be close to 0; that is, there will be only a few page faults. The effective access time is $\text{Effective access time} = (1-p) * ma + p * \text{page fault time}$.
 ma : memory-access time

6). Define secondary memory.

This memory holds those pages that are not present in main memory. The secondary memory is usually a high speed disk. It is known as the swap device, and the section of the disk used for this purpose is known as swap space.

7). What is the basic approach of page replacement?

If no frame is free is available, find one that is not currently being used and free it. A frame can be freed by writing its contents to swap space, and changing the page table to indicate that the page is no longer in memory. Now the freed frame can be used to hold the page for which the process faulted.

8) What are the various page replacement algorithms used for page replacement?

- ☐ FIFO page replacement
- ☐ Optimal page replacement
- ☐ LRU page replacement
- ☐ LRU approximation page replacement
- ☐ Counting based page replacement
- ☐ Page buffering algorithm.

9. What are the major problems to implement demand paging?

The two major problems to implement demand paging is developing
 a. Frame allocation algorithm b. Page replacement algorithm

10. What is a file?

A file is a named collection of related information that is recorded on Secondary storage. A file contains either programs or data. A file has certain “structure” based on its type.

- ☐ File attributes: Name, identifier, type, size, location, protection, time, date
- ☐ File operations: creation, reading, writing, repositioning, deleting, truncating, appending, renaming
- ☐ File types: executable, object, library, source code etc.

11. List the various file attributes.

A file has certain other attributes, which vary from one operating system to another, but typically consist of these: Name, identifier, type, location, size, Protection, time, date and user identification

12. What are the various file operations?

The six basic file operations are

- ☐ Creating a file
- ☐ Writing a file
- ☐ Reading a file
- ☐ Repositioning within a file
- ☐ Deleting a file
- ☐ Truncating a file

13. What are the information associated with an open file?

Several pieces of information are associated with an open file which may be:

- ☐ File pointer
- ☐ File open count
- ☐ Disk location of the file
- ☐ Access rights

14. What are the different accessing methods of a file?

The different types of accessing a file are:

- ☐ Sequential access: Information in the file is accessed sequentially
- ☐ Direct access: Information in the file can be accessed without any particular order.
- ☐ Other access methods: Creating index for the file, indexed sequential access method (ISAM) etc.

15. What is Directory?

The device directory or simply known as directory records information- such as name, location, size, and type for all files on that particular partition. The directory can be viewed as a symbol table that translates file names into their directory entries.

- ☐ Search for a file
- ☐ Create a file
- ☐ Delete a file
- ☐ Rename a file
- ☐ List directory
- ☐ Traverse the file system

16. What are the most common schemes for defining the logical structure of a directory?

The most common schemes for defining the logical structure of a directory

- ☐ Single-Level Directory
- ☐ Two-level Directory
- ☐ Tree-Structured Directories
- ☐ Acyclic-Graph Directories
- ☐ General Graph Directory

17. Define UFD and MFD.

In the two-level directory structure, each user has her own user file directory (UFD). Each UFD has a similar structure, but lists only the files of a single user. When a job starts the system's master file directory (MFD) is searched. The MFD is indexed by the user name or account number, and each entry points to the UFD for that user.

UNIT V

1).What are the various layers of a file system?

The file system is composed of many different levels. Each level in the design uses the feature of the lower levels to create new features for use by higher levels.

- ☐ Application programs
- ☐ Logical file system
- ☐ File-organization module
- ☐ Basic file system
- ☐ I/O control
- ☐ Devices

2) What are the structures used in file-system implementation?

Several on-disk and in-memory structures are used to implement a file system

- a. On-disk structure include
 - Boot control block
 - Partition block
- b. In-memory structure include
 - In-memory partition table
 - In-memory directory structure
 - System-wide open file table
 - Per-process open table

3). What are the functions of virtual file system (VFS)?

It has two functions

- a. It separates file-system-generic operations from their implementation defining a clean VFS interface. It allows transparent access to different types of file systems mounted locally.
- b. VFS is based on a file representation structure, called a vnode. It contains a numerical value for a network-wide unique file .The kernel maintains one vnode structure for each active file or directory.

4). Define seek time and latency time.

The time taken by the head to move to the appropriate cylinder or track is called seek time. Once the head is at right track, it must wait until the desired block rotates under the read- write head. This delay is latency time.

5). What are the allocation methods of a disk space?

Three major methods of allocating disk space which are widely in use are

- a. Contiguous allocation
- b. Linked allocation
- c. Indexed allocation

6). What are the advantages of Contiguous allocation?

The advantages are

- a. Supports direct access
- b. Supports sequential access
- c. Number of disk seeks is minimal.

7). What are the drawbacks of contiguous allocation of disk space?

The disadvantages are

- a. Suffers from external fragmentation
- b. Suffers from internal fragmentation
- c. Difficulty in finding space for a new file
- d. File cannot be extended
- e. Size of the file is to be declared in advance

8). What are the advantages of Indexed allocation?

The advantages are

- a. No external-fragmentation problem
- b. Solves the size-declaration problems.
- c. Supports direct access

9). How can the index blocks be implemented in the indexed allocation scheme?

The index block can be implemented as follows

- a. Linked scheme
- b. Multilevel scheme
- c. Combined scheme

10) Define rotational latency and disk bandwidth.

Rotational latency is the additional time waiting for the disk to rotate the desired sector to the disk head. The disk bandwidth is the total number of bytes transferred, divided by the time between the first request for service and the completion of the last transfer.

11). How free-space is managed using bit vector implementation?

The free-space list is implemented as a bit map or bit vector. Each block is represented by 1 bit. If the block is free, the bit is 1; if the block is allocated, the bit is 0.

12). Define buffering.

A buffer is a memory area that stores data while they are transferred between two devices or between a device and an application.

Buffering is done for three reasons

- a. To cope with a speed mismatch between the producer and consumer of a data stream
- b. To adapt between devices that have different data-transfer sizes
- c. To support copy semantics for application I/O

13). Define caching.

A cache is a region of fast memory that holds copies of data. Access to the cached copy is more efficient than access to the original. Caching and buffering are distinct functions, but sometimes a region of memory can be used for both purposes.

14). Define spooling.

A spool is a buffer that holds output for a device, such as printer, that cannot accept interleaved data streams. When an application finishes printing, the spooling system queues the corresponding spool file for output to the printer. The spooling system copies the queued spool files to the printer one at a time.

15. What is low-level formatting?

Before a disk can store data, it must be divided into sectors that the disk controller can read and write. This process is called low-level formatting or physical formatting. Low-level formatting fills the disk with a special data structure for each sector. The data structure for a sector consists of a header, a data area, and a trailer.

16. What is the use of boot block?

For a computer to start running when powered up or rebooted it needs to have an initial program to run. This bootstrap program tends to be simple. It finds the operating system on the disk loads that kernel into memory and jumps to an initial address to begin the operating system execution. The full bootstrap program is stored in a partition called the boot blocks, at fixed location on the disk. A disk that has boot partition is called boot disk or system disk.

17. What is sector sparing?

Low-level formatting also sets aside spare sectors not visible to the operating system. The controller can be told to replace each bad sector logically with one of the spare sectors. This scheme is known as sector sparing or forwarding.

16 MARK QUESTIONS

1. Explain the various types of computer systems. Mainframe systems .
2. Explain how protection is provided for the hardware resources by the operating System.
3. What are the system components of an operating system and explain them?
4. Write about the various system calls.
5. What are the various process scheduling concepts Scheduling queues with diagram
6. Explain about interprocess communication
7. Give an overview about threads
8. Explain in detail about the threading issues.
9. Write about the various CPU scheduling algorithms. First-come, first-served scheduling
10. What is critical section problem and explain two process solutions and multiple process solutions?
11. Explain what semaphores are, their usage, implementation given to avoid busy waiting and binary semaphores.
12. Explain the classic problems of synchronization.
13. Give a detailed description about deadlocks and its characterization Deadlock definition
14. Explain about the methods used to prevent deadlocks
15. Write in detail about deadlock avoidance
16. Explain the Banker's algorithm for deadlock avoidance
17. Explain about contiguous memory allocation
18. Write about the techniques for structuring the page table
19. Explain the basic concepts of segmentation. User view of program
20. What is demand paging and what is its use?
21. Explain the various page replacement strategies. Page replacement-basic scheme With diagram
22. What is thrashing and explain the methods to avoid thrashing?
23. What are files and explain the access methods for files?
24. Explain the schemes for defining the logical structure of a directory
25. Explain the allocation methods for disk space. Contiguous allocation advantage, disadvantage & diagram Linked allocation advantage, disadvantage & diagram Indexed allocation advantage, disadvantage & diagram
26. Explain the various disk scheduling techniques FCFS scheduling
27. Write notes about disk management and swap-space management. Disk formatting- low level formatting