UNIT 3: MEMORY MANAGEMENT

PART A

1. What are the steps in which address binding is carried out? (CO3-K1)

1. **Compile time**: If memory location known a priori, absolute code can be generated; must recompile code if starting location changes.
2. **Load time**: Must generate *relocatable* code if memory location is not known at compile time. Binding is delayed until load time.
3. **Execution time**: Binding delayed until run time if the process can be moved during its execution from one memory segment to another. Need hardware support for address maps (e.g., *base* and *limit registers*).

2. Define logical address and physical address. (CO3-K1)

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 the role of relocation-register?

The relocation register which is the part of the memory management unit which contains the value of the smallest physical address.

The MMU maps the logical address dynamically by adding the value in the relocation register to compute the physical.

The value in the relocation register is added to every address generated by a user process at the time the address is sent to memory.

4. What is the concept of external fragmentation? (CO3-K1)

External fragmentation exists when enough total memory space exists to satisfy a request, but it is not contiguous.

It is a memory management problem in which frequent requests and releases of groups of contiguous page frames of different sizes may lead to a situation in which several small blocks of free page frames are "scattered" inside blocks of allocated page frames. That is storage is fragmented into large number of small holes.

As a result, it may become impossible to allocate a large block of contiguous page frames, even if there are enough free pages to satisfy the request.

5. What is the concept of internal fragmentation? (CO3-K1)

The physical memory broken into fixed size blocks and allocate memory in unit of blocks and allocated memory may be slightly larger than requested memory; this

size difference is memory internal to a partition, but not being used. This is called as internal fragmentation.

6. What do you mean by best fit? (CO3-K1)

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.

7. What do you mean by first fit? (CO3-K1)

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.

8. What do you mean by worst fit? (CO3-K1)

Allocate the *largest* hole. It must also search entire list unless it is sorted by size. This strategy produces the largest leftover hole.

9. What is compaction? (CO3-K1)

Compaction shuffles memory contents to place **all free memory together** in one large block. Compaction is possible only if **relocation is dynamic**, and is done at execution time. Compaction provides solution to external fragmentation

10. Differentiate Paging and Segmentation.

Paging	Segmentation
Program is divided into fixed or mounted size pages.	Program is divided into variable size segments.
Page size is determined by hardware.	Segment size is given by the user.
For the paging operating system is accountable.	For segmentation compiler is accountable.
Faster in comparison to segmentation.	Segmentation is slow.
Paging could result in internal fragmentation.	Segmentation could result in external fragmentation.
In paging, the logical address is split into a page number and page offset.	Here, the logical address is split into segment number and segment offset.
Operating system must maintain a free frame list.	Operating system maintains a list of holes in the main memory.
Paging is invisible to the user.	Segmentation is visible to the user.

11. Describe: Translation Look-aside Buffer (TLB). (CO3-K1)

It is a special, small, **fast lookup hardware cache** which provides a solution for the problem of need of **two memory access** to access a byte. TLB is associative and **high speed memory**. It contains few of the page table entries and if the page number is found, its frame number is immediately available and used to access memory.

12. Define: TLB hit and TLB miss. (CO3-K1)

If a particular page number is **found in the TLB** that is termed as TLB hit. The percentage of it is termed as hit ratio.

If a particular page number is **not found in the TLB** that is termed as TLB miss

13. Define how protection is accomplished in paging.

Memory protection is a paged environment is accomplished by protection bits that are associated with each frame.

"Valid" (v) bit indicates that the associated page is in the process's logical address space, and is thus a legal page.

"Invalid" (i) bit indicates that the page is not in the process's logical address space.

14. What is virtual memory? (CO3-K1)

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.

15. What is Demand paging? (CO3-K1)

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.

16. Describe the concept of copy on write.

Copy-on-Write (COW) allows both parent and child processes to initially share the same pages in memory. If either process modifies a shared page, only then is the page copied.

17. What is Belady's anomaly? (CO3-K1)

In research it was noticed that in page replacement, when the number of allocated frame increases, the page fault rate decreases. But for some page replacement algorithms like FIFO, page fault rate may increase as the number of allocated frames increases. This most unexpected result is termed as Belady's anomaly.

18. What is dirty bit/modify bit? (CO3-K1)

It is a bit associated with each frame or page in the hardware. The modify bit for a page is set by the hardware whenever any word or byte in the page is written into, indicate that the **page has been modified**.

19. What is thrashing?

If a process does not have “enough” pages, the page-fault rate is very high. There is a situation that process must replace some page which is active in use. So a process is busy in swapping pages in and out rather than executing. This high paging activity is termed as thrashing.

20. What is working set model?

The working-set model is the solution for thrashing which based on the assumption of locality. This model uses a parameter, Δ, to define the working-set window.

The idea is to examine the most recent Δ page references. The set of pages in the most recent Δ page references is the working set

If a page is in active use, it will be in the working set. If it is no longer being used, it will drop from the working set Δ time units after its last reference.