Operating Systems

Sheet 1

Q1- Answer the following questions:

1- What is an operating system?
2- What is the difference among an operating system, kernel, system programs, and application programs?
3- List out different two services of Operating Systems and explain each service.
4- List Four resources that will be allocated by operating system to users and processes.
5- Distinguish among following terminologies:
i) Multiprogramming systems ii) Multitasking Systems iii) Multiprocessor systems.
6- What is the difference between:
a. Scheduler and dispatcher?
b. Preemptive and non preemptive scheduling
c. I/O bound task and CPU bound task
d. Paging and segmentation
7- Explain the concept of 'process'. Then, describe the contents of a process control block(PCB)
8- Draw a simple diagram that shows the different process states.
9- Describe the differences among short-term, medium-term, and long term scheduling.
10- What is a boot-strap program?
11- What is context switching?
12- Explain the difference between Hardware Interrupts and Software Interrupts.
13- What is paging and swapping?
14- With a diagram discuss the steps involved in handling a page fault.
15- What is address binding? Explain the concept of dynamic relocation of addresses.
16- Define external fragmentation. What are the causes for external fragmentation?
17- What is paging? Explain the paging hardware?
18- Differentiate between internal and external fragmentation.
19- Explain the difference between Physical and logical address.
20- What is fragmentation? Explain its types and disadvantages.
21- Explain the difference between "Multilevel Queue Scheduling" and "Multilevel Feedback Queue" Scheduling.
22- Explain the steps of I/O interrupt handling.
23- Explain how address binding of instructions and data to memory addresses can happen at different stages.
24- Explain why **Valid-invalid** bit attached to each entry in the page table.

Q2- State whether each of the following is TRUE or FALSE

1- An operating system manages system resources.
2- A programmer counter stores the address of the next instruction to be processed.
3- A PCB determines which process is to be executed next.
4- Time-sharing OS is a logical extension of the multi-programmed OS where user can interact with the program. The CPU executes multiple jobs by switching among them so frequent, to make the user feels as if the operating system is running only his program .
5- In Asymmetric multi processing each processor run an identical copy of the OS, and these copies communicate with each other as and when needed.
6- User programs cannot directly interact with the system resources, instead they request the operating system which checks the request and does the required task for the user programs.
7- System calls provide the interface between a process and the operating system.
8- Information associated with each process is stored in the schedular.
9- Operating systems act as resources allocators and control the execution of programs.
10- Dynamic Loading is useful when large amounts of code are needed to handle infrequently occurring cases as unused routines are never loaded.
11- Fragmentation occurs in a dynamic memory allocation system when all the free blocks are big enough to satisfy the required memory request.
12- Preemption generally does not increase the complexity of a scheduling problem.
13- Paging eliminates internal fragmentation.
14- Compaction can be used to solve the problem of internal fragmentation.
15- An operating system is interrupt driven
16- Device controller informs CPU that it has finished its operation by causing an interrupt.
17- Upon an I/O request by a user program, the I/O operation starts and control does not return to the user program until the I/O operation is finished.
18- In direct memory access, device controller transfers blocks of data from buffer storage directly to main memory without CPU intervention.
19- Disk surface is logically divided into sectors, which are subdivided into tracks.
20- In direct memory access, only one interrupt is generated per block, rather than the one interrupt per byte.
21- A process can be swapped temporarily out of memory to a backing store, and then brought back into memory for continued execution.
22- Roll out, roll in is a swapping variant used for priority-based scheduling algorithms; where higher-priority process is swapped out so lower-priority process can be loaded and executed.
23- Relocation registers used to protect user processes from each other, and from changing operating-system code and data.
24- Worst-fit and best-fit are usually better than First-fit in terms of speed and storage utilization

Q3- Select the correct answer in each of the following:

1. Each process is represented in the operating system by a ----------.
   A- handler B- PCB C- kernel D- bootstrap
2. The _____ refers to the number of processes in memory.
   A. degree of multiprogramming B. CPU schedular C. long-term scheduler D. process count
3. The ____ scheduling algorithm is designed especially for time-sharing systems.
   A. Multi-level Queue B. FCFS C. SJF D. RR
4. An address generated by a CPU is referred to as a _____.
   A. post relocation register address B. MMU address C. logical address D. physical address
5. The processes that are residing in the main memory and are ready and waiting to execute are kept on a list called the _____.
   A. Device Queue B. Waiting Queue C. Ready Queue D. Spooling Queue
6. Interrupt transfers control to the interrupt service routine generally, through the_____, which contains the addresses of all the service routines.
   A. Device Queue B. dispatcher C. interrupt vector D. schedular
7. Saving the state of the old process and loading the saved state for new process in order to transfer the control from one process to other process is called _____.
   A. Thrashing B. dispatcher C. swapping D. context switch
8. A _____ is a software-generated interrupt caused either by an error or a user request.
   A. system call B. interrupt handler C. trap D. interrupt vector
9. _____ schedulars are the job schedulers that select processes from the job queue and load them into memory for execution.
   A. Short term B. Medium term C. Long term D. None of the mentioned
10. _____ is solution to external fragmentation problem which is to permit the logical address space of a process to be noncontiguous, thus allowing a process to be allocating physical memory wherever the latter is available.
    A. Paging B. Segmentation C. Both A and B D. None of the mentioned
11. CPU scheduling decisions may take place when a process switches from _____ state.
    A. Running to waiting B. running to ready C. waiting to ready D. All the mentioned
12. _____ is defined as the number of processes that complete their execution per time unit.
    A. Turnaround time B. Response time C. Throughput D. Waiting Time
13. _____ is defined as the amount of time to execute a particular process.
    A. Turnaround time B. Response time C. Throughput D. Waiting Time
14. _____ is defined as amount of time a process has been waiting in the ready queue.
    A. Turnaround time B. Response time C. Throughput D. Waiting Time
15. _____ is defined as amount of time it takes from when a request was submitted until the first response is produced, not output.
    A. Turnaround time B. Response time C. Throughput D. Waiting Time
16. When _____ is used, a small piece of code, stub, used to locate the appropriate memory-resident library routine.
    A. Dynamic loading B. Dynamic linking C. paging D. All the mentioned
17. _____ is the space wasted inside of allocated memory blocks because of restriction on the allowed sizes of allocated blocks
    A. Internal fragmentation B. Thrashing C. External fragmentation D. None of the mentioned
18. The two separate modes of operating in a system are _____ mode and _____ mode .
    A. supervisor, system B. kernel, privileged C. physical, logical D. user, kernel
19. The list of processes waiting for a particular I/O device is called a(n) _____ queue.
    A. standby B. interrupt C. device D. ready
20. Consider a logical address with a page size of 8 KB. How many bits must be used to represent the page offset in the logical address?
    A. 10 B. 8 C. 13 D. 12
21. Consider a logical address with 18 bits used to represent an entry in a conventional page table. How many entries are in the conventional page table?

A. 262144 B. 1024 C. 1048576 D. 18

22. Assume a system has a associated memory hit ratio of 90%. It requires 15 nanoseconds to access the associated memory, and 85 nanoseconds to access main memory. What is the effective memory access time in nanoseconds for this system?

A. 108.5 B. 100 C. 22 D. 176.5

23. Given the logical address 0xAEF9 (in hexadecimal) with a page size of 256 bytes, what is the page number?

A. 0xAE B. 0xF9 C. 0xA D. 0x00F9

24. _____ is the only large storage media that the CPU can access directly.

A. registers B. Main memory C. Optical disks D. magnetic tapes

Q4- Answer the following questions:

1- Find the average turnaround time and average waiting time for the processes given in the table below.

Process	CPU burst-time (in ms)
P1	24
P2	3
P3	3

2- Consider the following set of processes, with the length of the CPU burst given in milliseconds:

Process	Burst-Time	Priority
P_1	12	4
P_2	10	2
P_3	8	5
P_4	7	1
P_5	4	3

The processes are assumed to have arrived in the order P_1, P_2, P_3, P_4, P_5, all at time 0.

3- Consider 5 processes with the following data (burst time given in milliseconds)

process	Burst-time	Priority
p1	10	3
p2	1	1
p3	2	3
p4	1	4
p5	5	2

The process has arrived in the order p1, p2, p3, p4, p5 all at time 0.

a. Draw Gantt charts for the execution of these processes using FCFS, SJF, a nonpreemptive priority and RR (quantum=1) scheduling.

b. What is the turnaround time and waiting time of each process for each of the scheduling algorithm.

4- For the following set of processes, find the average waiting time & average turn around time using GANTT Chart for

a- FCFS

b- SJF preemptive.

c- SJF non-preemptive.

Process	Arrival-time	Burst-Time
P1	0	4
P2	1	2
P3	2	5
P4	3	4

5- Consider the following set of rocesses, with the len of CPU burst in milliseconds.

Process	PI	P2	P3	P4	P5
Arrival-time	00	02	03	06	30
Burst-time	10	12	14	16	05

a- Draw a Gantt chart that illustrates the execution of these processes using the preemptive shortest job first (SJF) algorithm. Hence find the average waiting time.

b- Draw a Gantt chart that illustrate the execution of these processes using preemptive priority scheduling algorithm. Given priority of each process is PI = 4, P2=3, P3=5, P4= 1 and P5= 1. Also find the average waiting time

6- Suppose that processes P1, P2, . . . ,P5 arrive for execution at the times indicated in Table 1. Each process will run for the amount of time listed, and will be assigned a priority ranging from 0 (highest) to 10 (lowest). No more processes will arrive until the last process completes.

In answering the questions, base all decisions on the information you have at the time the decision must be made.

Table 1: Process arrival/CPU-burst times and priorities.

Process	Arrival-Time	Burst-Time	Priority
P1	0.0	8	10
P2	0.4	4	2
P3	0.5	1	10
P4	0.8	2	1
P5	1.0	2	5

A- Draw four Gantt charts that illustrate the execution of these processes using the following scheduling algorithms:
- FCFS;
- preemptive SJF;
- preemptive priority (SJF if priority is equal);
- RR (quantum=2).

B- What is the turnaround time of each process for each of these four scheduling algorithms?

C- What is the waiting time of each process for each of these four scheduling algorithms?

D- Which of the algorithms results in the maximum overall turnaround time (over all processes)?

7- Memory partitions of 100kb,500 kb,200 kb,300kb,600 kb are available how would best ,worst, first fit algorithm to place processes 212,417,112,426 in order. Which is the best algorithm?

8- Consider a logical address space of 8 pages of 1024 words each, mapped on to a physical memory of 32 frames.
a. How many bits are there in the logical address?
b. How many bits are there in the physical address?

9- The available space list of a computer memory is specified as follows:

Start-address	block-size-in-words
100	50
200	150
450	600
1200	400

Determine the available space list after allocating the space for the stream of requests consisting of the following block sizes: 25,100,250,200,100,150 using the following algorithms:

i- FIRST FIT.
ii- BEST FIT.
iii- WORST FIT.

10- Given memory partitions of 100 K, 500 K, 200 K, 300 K and 600 K (in order) how would each of the first fit, best fit and worst fit algorithms place processes of 212 K, 417K, 112 K and 426 K (in order)? Which algorithm makes the most efficient use of memory?

11- Assume that Page size = 4,096 bytes and Process size = 72,766 bytes. Calculate the number of pages and internal fragmentation?

12- Calculate the page table size for basic paging for if a 24-bit logical address space is assumed with a Page size of 2 KB