ANSWER ALL THE QUESTIONS
Use of GANTT Chart is mandatory in all Answer
Assume Missing Data If Any

1. Consider the following set of processes, with the length of the CPU burst time given in milliseconds:

Process	Burst Time	Priority
*P*1	2	2
*P*2	1	1
*P*3	8	4
*P*4	4	2
*P*5	5	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.
a. Draw four Gantt charts that illustrate the execution of these processes using the following scheduling algorithms: FCFS, SJF, non preemptive priority (a larger priority number implies a higher
priority), and RR (quantum = 2).
b. What is the turnaround time of each process for each of the scheduling algorithms in part a?
c. What is the waiting time of each process for each of these scheduling algorithms?
d. Which of the algorithms results in the minimum average waiting time (over all processes)?

2. The following processes are being scheduled using a preemptive, round robin scheduling algorithm.

Process	Priority	Burst	Arrival
*P*1	40	20	0
*P*2	30	25	25
*P*3	30	25	30
*P*4	35	15	60
*P*5	5	10	100
*P*6	10	10	105

Each process is assigned a numerical priority,with a higher number indicating a higher relative priority. In addition to the processes listed below, the system also has an **idle task** (which consumes no CPU resources and is identified as *Pidle*). This task has priority 0 and is scheduled whenever
the system has no other available processes to run. The length of a time quantum is 10 units. If a process is preempted by a higher-priority process, the preempted process is placed at the end of the queue.
a. Show the scheduling order of the processes using a Gantt chart.
b. What is the turnaround time for each process?
c. What is the waiting time for each process?
d. What is the CPU utilization rate?

3. Three process p1, P2 and P3 arrive at time zero. Their total execution time is 10ms, 15ms, and 20ms respectively. They spent first 30% of their execution time in doing I/O, next 40% in CPU

processing and the last 30% again doing I/O. For what percentage of time was the CPU free? Use Round robin algorithm with time quantum 5ms.

4. Three process P1, P2 and P3 arrive at time zero. The total time spent by the process in the system is 10ms, 20ms, and 30ms respectively. They spent first 40% of their execution time in doing I/O and the rest 60% in CPU processing. What is the percentage utilization of CPU using FCFS scheduling algorithm?

5. Suppose that the following processes arrive for execution at the times indicated. Each process will run for the amount of time listed. In answering the questions, use non-preemptive scheduling, and base all decisions on the information you have at the time the decision must be made.

Process	Arrival Time	Burst Time
*P*1	0.0	8
*P*2	0.4	4
*P*3	1.0	1

a. What is the average turnaround time for these processes with the FCFS scheduling algorithm?

b. What is the average turnaround time for these processes with the SJF scheduling algorithm?

c. The SJF algorithm is supposed to improve performance, but notice that we chose to run process *P*1 at time 0 because we did not know that two shorter processes would arrive soon. Compute what the average turnaround time will be if the CPU is left idle for the first 1 unit and then SJF scheduling is used.

6. Considrer the following CPU processes with arrival times (in miliseconds) and length of CPU bursts (in miliseconds) as given below:

Process	Arrival time	Burst time
P1	0	7
P2	3	3
P3	5	5
P4	6	2

If the pre-emptive shortest remaining time first scheduling algorithm is used to schedule the processes, then the average waiting time across all processes is _____ milliseconds.

7. For the processes listed in the following table, which of the scheduling schemes will give the lowest average turnaround time?

Process	Arrival Time	Processing Time
A	0	3
B	1	6
C	4	4
D	6	2

8. Consider the following set of processes that need to be scheduled on a single CPU. All the times are given in milliseconds.

Process Name	Arrival Time	Execution Time
A	0	6
B	3	2
C	5	4
D	7	6
E	10	3

Using the *shortest remaining time first* scheduling algorithm, the average process turnaround time (in msec) is _____.

9. Consider the set of 4 processes whose arrival time and burst time are given below-

Process No.	**Arrival Time**	**Priority**	**Burst Time**		
			CPU Burst	**I/O Burst**	**CPU Burst**
P1	0	2	1	5	3
P2	2	3	3	3	1
P3	3	1	2	3	1

If the CPU scheduling policy is Priority Scheduling, calculate the average waiting time and average turn around time. (Lower number means higher priority)

10. Consider three process, all arriving at time zero, with total execution time of 10, 20 and 30 units respectively. Each process spends the first 20% of execution time doing I/O, the next 70% of time doing computation, and the last 10% of time doing I/O again. The operating system uses a shortest remaining compute time first scheduling algorithm and schedules a new process either when the running process gets blocked on I/O or when the running process finishes its compute burst. Assume that all I/O operations can be overlapped as much as possible. For what percentage of does the CPU remain idle?

1.0%

2. 10.6%

3. 30.0%

4. 89.4%