1. Consider the following five processed arriving at time 0 ms in the given order burst time given in ms. Using RR (time slice = 10ms) scheduling algorithm, find the average waiting time.

Process	Burst time
P1	10
P2	20
P3	6
P4	8
P5	16

2. Consider the following processes arriving at time 0 ms in the given order, the burst time given in ms. Using SJF scheduling algorithm draw the Gantt chart and find the average waiting time.

    Processes: P1, P2, P3

    Burst Time: 3,3,24

3. Consider the following processes arriving at time 0 ms in the given order, the burst time given in ms. Using FCFS scheduling algorithm draw the Gantt chart and find the average waiting time.

    Processes: P1, P2, P3

    Burst Time: 24,3,3

4. Consider the following processes arriving at time 0 ms in the given order, the burst time given in ms. Using Priority scheduling algorithm, draw the Gantt chart and find the average waiting time.

    Processes: P1, P2, P3, P4, P5

    Burst Time: 6,3,4,1,8

    Priority: 3,2,5,1,4 (Assume 5 has highest priority)

5. Consider the following processes arriving at time 0 ms in the given order, the burst time given in ms. Using SRTF scheduling algorithm draw the Gantt chart and find the average waiting time.

    Processes: P1, P2, P3, P4, P5

    Arrival Time: 0,1,2,3,4

    Burst Time: 4,3,1,2,5

6. Consider the following processes arriving at different time as given and burst time given in ms. Using FCFS scheduling algorithm, find the average waiting time.

Process	Arrival Time	Burst time
P1	0	6
P2	1	3
P3	2	1
P4	3	4

7. Consider the following processes arriving at time 0 ms in the given order, the burst time given in ms. Using RR scheduling algorithm (TQ = 1ms) draw the Gantt chart and find the average waiting time.
    Processes: P1, P2, P3
    Burst Time: 24,3,3

8. Consider the following processes arriving at time 0 ms in the given order, the burst time given in ms. Using Priority scheduling algorithm, draw the Gantt chart and find the average waiting time.
    Processes: P1, P2, P3, P4, P5
    Burst Time: 3,2,4,1,5
    Priority: 4,3,2,5,1

9. Consider the following data and calculate Average Turnaround Time and Average Waiting Time using SJF scheduling algorithm.

Process	Arrival Time	Burst time
P1	0	6
P2	0	8
P3	0	7
P4	0	3

10. Consider the following processes arriving at different time in the below order, the burst time given in ms. Using RR scheduling algorithm (TQ = 2ms) draw the Gantt chart and find the average waiting time.
    Processes: P1, P2, P3, P4, P5, P6
    Arrival Time: 0,1,2,4,6,7
    Burst Time: 4,5,6,1,3,2

11. Given the following, Calculate the average waiting time using Priority Scheduling.

Process	CPU burst in ms	Priority	Arrival
P1	6	2	0
P2	12	4	0
P3	1	5	0
P4	3	1	0
P5	4	3	0

12. A system has 12 magnetic tape drives and 3 processes: P0, P1, and P2. Process P0 requires 10 tape drives, P1 requires 4 and P2 requires 9 tape drives.

Process: P0, P1, P2

Maximum Needs (Process-wise: P0through P2 top to bottom) - 10 ,4, 9

Currently allocated (process-wise): 5, 2, 2

    A)   Check whether the system is in safe state? If so, write the safe sequence.

    B)   If P1 request additional 3 tape drives, can it be granted immediately and what will be the state if the system?

13. Consider the following set of processes, with the length of the CPU-burst time given in milli seconds. The processes are assumed to have arrived in the order p1, p2, p3, p4, p5 all at time 0.
A.   Draw Gantt charts illustrating the execution of these processes using FCFS, SJF scheduling.
B.   What is the turnaround time of each process for each of the scheduling algorithm in part A.?
C.   What is the waiting time of each process for each of the scheduling algorithms in part A.?
D.   Which of the schedules in part A results in minimal average waiting time?

Process	Burst Time
P1	10
P2	1
P3	2
P4	1
P5	5

14. Five batch jobs A, B, C, D and E arrive at a computer center at almost at the same time. They have estimated running times of 10,6,2,4 and 8 minutes. Their priorities are 3,5,2,1 and 4 respectively, with 5 being the highest priority. For each of the following scheduling algorithm determine the turnaround time and waiting time of each process. Mention which algorithm results in minimal average waiting time.

   i) Round Robin (Time Quantum = 2ms)

   ii) Priority scheduling

   iii) First come first served

   iv) Shortest job first.

15. Consider the following five processes arriving at time 0 ms in the given order, the burst time given in ms. Using SRTF and RR (time slice = 10ms) scheduling algorithm, draw the Gantt chart for the same and find the average waiting time and average Turnaround time.

Process	Burst time
P1	10
P2	30
P3	5
P4	9
P5	16

16. Consider the following five processes arriving at time 0 ms in the given order, the burst time given in ms. Draw the Gantt chart using Pre-emptive

Priority Scheduling and Non-pre-emptive SJF. Find the average waiting time and average Turnaround time for the same.

Process	Burst time	Priority
P1	10	3
P2	1	1
P3	2	4
P4	1	5
P5	5	2

17. Consider the following set of process with length of CPU burst time in milliseconds arrived with different arrival time as below.

Process	Arrival time	Burst time
P1	0	5
P2	1	8
P3	2	7
P4	3	9

Draw the Gantt chart illustrating the execution of these using FCFS, SJF algorithm and calculate the average waiting time and average turnaround time.

18. Consider the following set of process with length of CPU burst time in milliseconds arrived with different arrival time as below.

Process	Arrival time	Burst time
P1	0	10
P2	1	4
P3	2	8
P4	3	6

Draw Gantt charts illustrating the execution of these using SJF and SRTF algorithm and calculate the average waiting time and average turn around time.

19. Consider the following set of processes, with the length of the CPU-burst time given in milli seconds. The processes are assumed to have arrived in the order p1, p2, p3, p4, p5 all at time 0.

A.   Draw Gantt charts illustrating the execution of these processes using non-pre-emptive Priority scheduling and RR (quantum = 1ms) scheduling.

B.   What is the turnaround time of each process for each of the scheduling algorithm in part A.?

C.   What is the waiting time of each process for each of the scheduling algorithms in part A.?

D.   Which of the schedules in part A results in minimal average waiting time?

Process	Burst Time	Priority
P1	10	3
P2	1	1
P3	2	3
P4	1	4
P5	5	2

20. Consider the following snapshot of a system. Answer the following questions using Bankers Algorithm

Process	Allocation				Max				Available			
	A	B	C	D	A	B	C	D	A	B	C	D
P0	0	0	1	2	0	0	1	2	1	5	2	0
P1	1	0	0	0	1	7	5	0				
P2	1	3	5	4	2	3	5	6				
P3	0	6	3	2	0	6	5	2				
P4	0	0	1	4	0	6	5	6				

1. What is the content of Need Matrix.

2. Is the system in a safe state?

3. If a request from process P1 arrives for (0,4,2,0) can the request be immediately granted?

21. Consider the following snapshot of a system. Answer the following questions using Bankers Algorithm

Process	Allocation			Max			Available		
	A	B	C	A	B	C	A	B	C
P0	0	1	0	7	5	3	3	3	2
P1	2	0	0	3	2	2			
P2	3	0	2	9	0	2			
P3	2	1	1	2	2	2			
P4	0	0	2	4	3	3			

i.   What is the content of Need Matrix?

ii.   Is the system in a safe state? if so, write the Safe sequence.

iii.   If a request from process P1 arrives for (1,0,2) can the request be immediately granted?

22. Consider the following set of processes, with the length of CPU burst in milliseconds.

Process: P1, P2, P3, P4, P5.

Arrival time: 00, 02, 03, 06, 30.

Burst time: 10, 12, 14, 16, 05.

i.   Draw a Gantt chart that illustrates the execution of these processes using the preemptive shortest job first algorithm and find the average waiting time.

ii.   Draw a Gantt chart that illustrate the execution of these processes using preemptive priority scheduling algorithm. Given priority of each process is P1= 4, P2=3, P3=5, P4= 1 and P5= 1. Also find the average waiting time.

23. Consider the following set of process with length of CPU burst time in milliseconds arrived with different arrival time as below.

Process	Arrival time	Burst time	Priority
P1	0	6	3
P2	1	8	2
P3	2	7	1
P4	3	3	4

Draw Gantt charts illustrating the execution of these using SJF, SRTF and Pre-emptive scheduling algorithm and calculate the average waiting time for the same.

24. Consider the following set of process with length of CPU burst time in milliseconds arrived with different arrival time as below.

Process	Arrival time	Burst time
P1	0	4
P2	1	5
P3	2	2
P4	3	1
P5	4	6
P6	6	3

Draw Gantt charts illustrating the execution of these using RR algorithm for the given time quantum a) TQ=2ms b) TQ=4ms and calculate the average waiting time and average turn around time.

25. Consider the following set of process with length of CPU burst time in milliseconds arrived with different arrival time as below.

Process	Arrival time	Burst time
P1	0	10
P2	0	1
P3	3	2
P4	5	1
P5	10	5

Draw Gantt charts illustrating the execution of these using
A.   SJF
B.   Non-Pre-emptive Priority
C.   Round Robin (TS = 2ms)
D.   Calculate the average waiting time using the above algorithms.

26. A system has 18 magnetic tape drives and 3 processes: P0, P1, P2 and P3. Process P0 requires 12 tape drives, P1 requires 9, P2 requires 18 tape drives and P3 requires 5 tape drives

Process: P0, P1, P2, P3

Maximum Needs (Process-wise: P0 through P3 top to bottom) 12,9,18,5

Currently allocated (process-wise): 6,3,4,1

A)   Check whether the system is in safe state? If so, write the safe sequence.

B)   If P3 request additional 2 tape drives, can it be granted immediately? if so, write the safe sequence. If not, what will be the state if the system? explain the scenario.