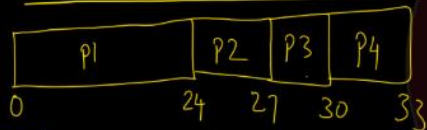


FCFS (First Come First Serve)

Process No	Arrival Time	Burst Time	Completion Time	Turnaround Time	Wait Time	Response Time	TAT	WT
p1	0	24	24				CT-AT	TAT-BT
p2	0	3	27					
p3	0	3	30					
p4	0	3	33					

I. Gantt Chart



II. Completion time according to Gantt Chart:-

P1 → 24 P3 → 30
 P2 → 27 P4 → 33

III. Calculate Turnaround Time

$$\text{Turnaround Time} = \text{Completion time} - \text{Arrival time}$$

P1 → 24 = 24 - 0
 P2 → 27 = 27 - 0
 P3 → 30 = 30 - 0
 P4 → 33 = 33 - 0

IV. Calculate Average Turnaround Time

$$\text{Average Turnaround Time} = \frac{\text{Sum of Turnaround times of all the processes}}{\text{No. of processes}}$$

$$= \frac{24 + 27 + 30 + 33}{4} = 28.5$$

FCFS (First Come First Serve)

Process No	Arrival Time	Burst Time	Completion Time	Turnaround Time	Wait Time	Response Time	TAT	WT
p1	0	24	24	24			CT-AT	TAT-BT
p2	0	3	27	27				
p3	0	3	30	30				
p4	0	3	33	33				

V. Calculate Wait Time:-

$$\text{Wait Time} = \text{Turnaround time} - \text{Burst time}$$

P1 → 0 = 24 - 24
 P2 → 24 = 27 - 3
 P3 → 27 = 30 - 3
 P4 → 30 = 33 - 3

VI. Calculate Average Wait Time

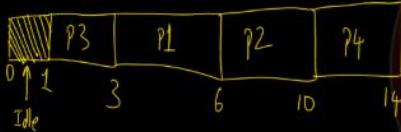
$$\text{Average Wait Time} = \frac{\text{Sum of Wait times of all the processes}}{\text{No. of processes}}$$

$$= \frac{0 + 24 + 27 + 30}{4} = 20.25$$

SJF (Shortest Job First) (Non-preemptive)

Process No	Arrival Time	Burst Time	Completion Time	Turnaround Time	Wait Time	Response Time	TAT	WT
p1		1	3	6			CT-AT	TAT-BT
p2		2	4	10				
p3		1	2	3				
p4		4	4	14				

I. Gantt Chart



II. Completion time according to Gantt chart: -

$p1 \rightarrow 6$ $p3 \rightarrow 3$
 $p2 \rightarrow 10$ $p4 \rightarrow 14$

III. Calculate Turnaround time:-

$$\text{Turnaround Time} = \text{Completion Time} - \text{Arrival Time}$$

$p1 \rightarrow 5 = 6 - 1$
 $p2 \rightarrow 8 = 10 - 2$
 $p3 \rightarrow 2 = 3 - 1$
 $p4 \rightarrow 10 = 14 - 4$

IV. Calculate Average Turnaround Time:-

$$\text{Average Turnaround Time} = \frac{\text{Turnaround time of all the process}}{\text{no. of process}}$$

$$= \frac{5+8+2+10}{4} = 6.25$$

SJF (Shortest Job First) (Non-preemptive)

Process No	Arrival Time	Burst Time	Completion Time	Turnaround Time	Wait Time	Response Time	TAT	WT
p1		1	3	5	2		CT-AT	TAT-BT
p2		2	4	8	4			
p3		1	2	2	0			
p4		4	4	10	6			

V. Calculate wait Time: -

$$\text{Wait Time} = \text{Turnaround Time} - \text{Burst Time}$$

$p1 \rightarrow 2 = 5 - 3$
 $p2 \rightarrow 4 = 8 - 4$
 $p3 \rightarrow 0 = 2 - 2$
 $p4 \rightarrow 6 = 10 - 4$

VI. Calculate Average wait Time

$$\text{Average wait Time} = \frac{\text{wait time of all the process}}{\text{no. of process}}$$

$$= \frac{2+4+0+6}{4} = 3$$

SRTF (Shortest Remaining Time First)

cpu

Process No	Arrival Time	Burst Time	Completion Time	Turnaround Time	wait Time	Response Time	TAT	WT	RT
p1	0	5					CT-AT	TAT-BT	CPU First Time - AT
p2	1	3							
p3	2	4							
p4	4	1							



I. Gantt Chart



Working Notes:-

P1 → 5 4 0
P2 → 3 2 0
P3 → 4 0
P4 → 1 0

II. Calculate Completion Time:-

P1 → 9

P2 → 4

P3 → 13

P4 → 5

SRTF (Shortest Remaining Time First)

Process No	Arrival Time	Burst Time	Completion Time	Turnaround Time	wait Time	Response Time	TAT	WT	RT
p1	0	5	9	9			CT-AT	TAT-BT	CPU First Time - AT
p2	1	3	4	3					
p3	2	4	13	11					
p4	4	1	5	1					



III. Calculate Turnaround Time:-

Turnaround Time = Completion Time - Arrival Time

P1 → 9 = 9 - 0

P2 → 3 = 4 - 1

P3 → 11 = 13 - 2

P4 → 1 = 5 - 4

IV. Calculate wait Time:-

wait Time = TAT - BT

P1 → 4 = 9 - 5

P2 → 0 = 3 - 3

P3 → 7 = 11 - 4

P4 → 0 = 1 - 1

V. Calculate Average wait Time:-

Avg. wait Time = $\frac{\text{WT of all process}}{\text{No. of process}}$

= $\frac{4+0+7+0}{4}$

= 2.75

IV. Calculate average Turnaround Time

Average TAT = $\frac{\text{TAT of process}}{\text{No. of process}} = \frac{9+3+11+1}{4} = 6$

SRTF (Shortest Remaining Time First)

Process No	Arrival Time	Burst Time	Completion Time	Turnaround Time	wait Time	Response Time	TAT	WT	RT
p1	0	5					CT-AT	TAT-BT	CPU First Time - AT
p2	1	3							
p3	2	4							
p4	4	1							

VII Calculate Response Time:-

$$\text{Response Time} = \text{CPU First Time} - \text{Arrival Time}$$

P1 → 0 - 0 = 0
 P2 → 0 - 1 = 1
 P3 → 7 - 9 = 2
 P4 → 0 - 4 = 4

VIII calculate Avg Response Time:-

$$\text{Avg Response Time} = \frac{0 + 0 + 7 + 0}{4} = 1.75$$

RR → Round Robin (Preemptive) Time Quantum = 2ms

Process No	Arrival Time	Burst Time	Completion Time	Turnaround Time	wait Time	Response Time	CPU	TAT	WT	RT
p1	0	5					0	CT-AT	TAT-BT	CPU First Time - AT
p2	1	4					2			
p3	2	2					4			
p4	4	1					8			

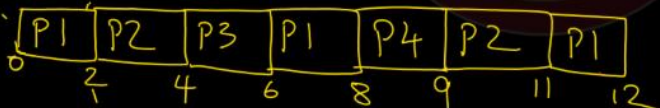
I. Working Notes:-

P1 → ~~5~~ 3 1 0
 P2 → ~~4~~ 2 0
 P3 → ~~2~~ 0
 P4 → ~~1~~ 0

Ready Queue:-



Gantt Chart:-



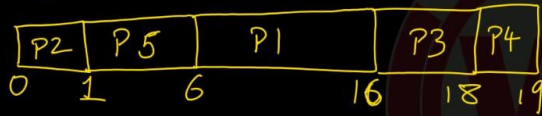
II. Completion Time:-

P1 → 12
 P2 → 11
 P3 → 6
 P4 → 9

Priority Scheduling (Non-Preemptive)

Process No	Burst Time	Priority	Completion Time	Turnaround Time	Wait Time	TAT	WT
p1	10	3	16	16		CT-AT	TAT-BT
p2	1	1	1	1			
p3	2	3	18	18			
p4	1	4	19	19			
p5	5	2	6	6			

I. Gantt Chart



II. Completion time according to Gantt Chart:-

$P1 \rightarrow 16$ $P4 \rightarrow 19$
 $P2 \rightarrow 1$ $P5 \rightarrow 6$
 $P3 \rightarrow 18$

III. Calculate Turnaround Time

$$\text{Turnaround Time} = \text{Completion Time} - \text{Arrival Time}$$

$P1 \rightarrow 16 = 16 - 0$
 $P2 \rightarrow 1 = 1 - 0$
 $P3 \rightarrow 18 = 18 - 0$
 $P4 \rightarrow 19 = 19 - 0$
 $P5 \rightarrow 6 = 6 - 0$

IV. Calculate Average turnaround time

$$\text{Average Turnaround Time} = \frac{\text{Turnaround time of all process}}{\text{No. of process}}$$

$$= \frac{16 + 1 + 18 + 19 + 6}{5}$$

$$= 12 \text{ ms}$$

Priority Scheduling (Non-Preemptive)

Process No	Burst Time	Priority	Completion Time	Turnaround Time	Wait Time	TAT	WT
p1	10	3	16	16	6	CT-AT	TAT-BT
p2	1	1	1	1	0		
p3	2	3	18	18	16		
p4	1	4	19	19	18		
p5	5	2	6	6	1		

I. Calculate wait Time:-

$$\text{Wait Time} = \text{Turnaround Time} - \text{Burst Time}$$

$P1 \rightarrow 6 = 16 - 10$
 $P2 \rightarrow 0 = 1 - 1$
 $P3 \rightarrow 16 = 18 - 2$
 $P4 \rightarrow 18 = 19 - 1$
 $P5 \rightarrow 1 = 6 - 5$

II. Calculate Average wait Time:-

$$\text{Average wait Time} = \frac{\text{Wait time of all the process}}{\text{No. of process}}$$

$$= \frac{6 + 0 + 16 + 18 + 1}{5}$$

$$= 8.2 \text{ ms}$$

Priority Scheduling (Preemptive) (Higher the No, higher the priority)

Process No	Arrival Time	Burst Time	Priority	Completion Time	Turnaround Time	Wait Time	TAT	WT
p1	0	5	1				CT-AT	TAT-BT
p2	1	4	2					
p3	2	2	3					
p4	4	1	4					

P.No Burst Time Arrival Priority
 P1
 P2
 P3

Priority Scheduling (Preemptive) (Higher the No, higher the priority)

Process No	Arrival Time	Burst Time	Priority	Completion Time	Turnaround Time	Wait Time	TAT	WT
p1	0	5	1	12	12		CT-AT	TAT-BT
p2	1	4	2	8	7			
p3	2	2	3	4	2			
p4	4	1	4	5	1			

III. Calculate Turnaround Time:-

$$\begin{aligned}
 \text{Turnaround Time} &= \text{Completion Time} - \text{Arrival Time} \\
 P1 \quad 12 &= 12 - 0 \\
 P2 \quad 7 &= 8 - 1 \\
 P3 \quad 2 &= 4 - 2 \\
 P4 \quad 1 &= 5 - 4
 \end{aligned}$$

IV Calculate Average Turnaround time:-

$$\begin{aligned}
 \text{Average Turnaround Time} &= \frac{\text{TAT of all the processes}}{\text{No. of processes}} \\
 &= \frac{12 + 7 + 2 + 1}{4} \\
 &= \underline{\underline{5.5 \text{ ms}}}
 \end{aligned}$$

Priority Scheduling (Preemptive) (Higher the no, higher the priority)

Process No	Arrival Time	Burst Time	Priority	Completion Time	Turnaround Time	Wait Time	TAT	WT
p1	0	5	1	12	12	7	CT-AT	TAT-BT
p2	1	4	2	8	7	3		
p3	2	2	3	4	2	0		
p4	4	1	4	5	1	0		

↓ Calculate wait time

$$\text{Wait Time} = \text{TAT} - \text{BT}$$

$$P_1 \quad 7 = 12 - 5$$

$$P_2 \quad 3 = 7 - 4$$

$$P_3 \quad 0 = 2 - 2$$

$$P_4 \quad 0 = 1 - 1$$

2.5 ms

For the page reference string 7,0,1,2,0,3,0,4,2,3,0,3,2,1,2,0,1,7,0,1 Calculate the page faults applying: i) optimal ii) LRU iii) FIFO page

Replacement algorithms for a memory with three frames. (S - 23)

Reference String	7	0	1	2	0	3	0	4	2	3	0	3	2	1	2	0	1	7	0	1
Frame 1	7	7	7	2	2	2	2	4	4	4	0	0	0	0	0	0	0	7	7	7
Frame 2		0	0	0	0	3	3	3	2	2	2	2	2	1	1	1	1	1	0	0
Frame 3			1	1	1	1	0	0	0	3	3	3	3	3	2	2	2	2	2	1
Page Fault	F	F	F	F	H	F	F	F	F	F	F	H	H	F	F	H	H	F	F	F

No. of Faults = 15 | No. of Hits = 5

FIFO

For the page reference string 7,0,1,2,0,3,0,4,2,3,0,3,2,1,2,0,1,7,0,1 Calculate the page faults applying: i) optimal ii) LRU iii) FIFO page Replacement algorithms for a memory with three frames. (S - 23)



Reference String	7	0	1	2	0	3	0	4	2	3	0	3	2	1	2	0	1	7	0	1
Frame 1	7	7	7	2	2	2	2	4	4	4	0	0	0	1	1	1	1	1	1	1
Frame 2		0	0	0	0	0	0	0	3	3	3	3	3	3	3	0	0	0	0	0
Frame 3			1	1	1	3	3	3	2	2	2	2	2	2	2	2	2	7	7	7
Page Fault	F	F	F	F	H	F	H	F	F	F	F	H	H	F	H	F	H	F	H	H

No. of Faults = 12 No. of Hits = 8

LRU

For the page reference string 7,0,1,2,0,3,0,4,2,3,0,3,2,1,2,0,1,7,0,1 Calculate the page faults applying: i) optimal ii) LRU iii) FIFO page Replacement algorithms for a memory with three frames. (S - 23)



Reference String	7	0	1	2	0	3	0	4	2	3	0	3	2	1	2	0	1	7	0	1
Frame 1	7	7	7	2	2	2	2	2	2	2	2	2	2	2	2	2	2	7	7	7
Frame 2		0	0	0	0	0	0	4	4	4	0	0	0	0	0	0	0	0	0	0
Frame 3			1	1	1	3	3	3	3	3	3	3	3	1	1	1	1	1	1	1
Page Fault	F	F	F	F	H	F	H	F	H	H	F	H	H	F	H	H	H	F	H	H

No. of Faults = 09 | No. of Hits = 11

OPTIMAL