

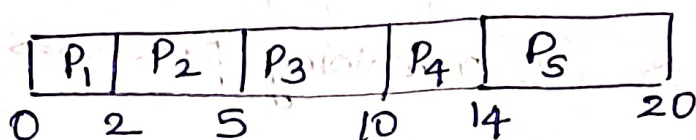
Find avg. waiting time & turnaround time for the following questions. Pg ①

1) Algorithm \rightarrow FCFS

Process	Arrival	Burst time
P_1	0	2
P_2	1	3
P_3	2	5
P_4	3	4
P_5	4	6

Soln:-

Gantt chart



Turnaround time = Completion - arrival
(TAT)

Waiting time = TAT - Burst time.

TAT:-

$$P_1 \Rightarrow 2 - 0 = 2$$

$$P_2 \Rightarrow 5 - 1 = 4$$

$$P_3 \Rightarrow 10 - 2 = 8$$

$$P_4 \Rightarrow 14 - 3 = 11$$

$$P_5 \Rightarrow 20 - 4 = 16$$

Avg TAT

$$\frac{41}{5} = 8.2$$

Waiting time

$$P_1 \Rightarrow 2 - 2 = 0$$

$$P_2 \Rightarrow 4 - 3 = 1$$

$$P_3 \Rightarrow 8 - 5 = 3$$

$$P_4 \Rightarrow 11 - 4 = 7$$

$$P_5 \Rightarrow 16 - 6 = 10$$

$$\text{Avg. waiting time} = \frac{21}{5} = 4.2$$

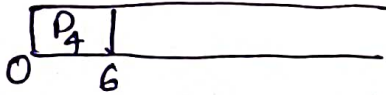
(2) Process	Arrival time	Burst time
P ₁	3	1
P ₂	1	4
P ₃	4	2
P ₄	0	6
P ₅	2	3

Algorithm \rightarrow SJF non-preemptive

Soln:-

(i) SJF non preemptive

(1) @ time = 0 \Rightarrow only P₄ is present

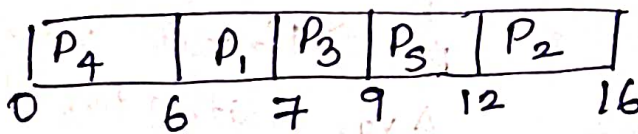


(2) @ time = 6 \Rightarrow all remaining processes are present

Process	Burst
P ₁	1
P ₂	4
P ₃	2
P ₅	3

Pick processes in order of burst time i.e

P₁, P₃, P₅, P₂



TAT = completion - arrival

$$P_1 \rightarrow 7 - 3 = 4$$

$$P_2 \rightarrow 16 - 1 = 15$$

$$P_3 \rightarrow 9 - 4 = 5$$

$$P_4 \rightarrow 6 - 0 = 6$$

$$P_5 \rightarrow 12 - 2 = 10$$

$$\text{Avg TAT} = \frac{40}{5} = 8$$

Waiting = TAT - burst

$$P_1 \rightarrow 4 - 1 = 3$$

$$P_2 \rightarrow 15 - 4 = 11$$

$$P_3 \rightarrow 5 - 2 = 3$$

$$P_4 \rightarrow 6 - 6 = 0$$

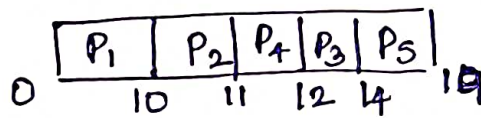
$$P_5 \rightarrow 10 - 3 = 7$$

$$\frac{24}{5} = 4.8$$

(3) April 2019 - Sem

	Burst	Priority	Arrival
P_1	10	3	0
P_2	1	1	1
P_3	2	3	2
P_4	1	4	1
P_5	5	2	2

Draw gantt chart using FCFS, SJF, SRTS, round robin with time quantum of 2ms, preemptive and non-preemptive priority, find avg TAT and waiting time.

(i) FCFS

TAT = completion - arrival

$$P_1 = 10 - 0 = 10$$

$$P_2 = 11 - 1 = 10$$

$$P_3 = 14 - 2 = 12$$

$$P_4 = 12 - 1 = 11$$

$$P_5 = 19 - 2 = 17$$

$$\text{Avg TAT} = \frac{60}{5} = 12$$

Waiting = TAT - burst

$$P_1 = 10 - 10 = 0$$

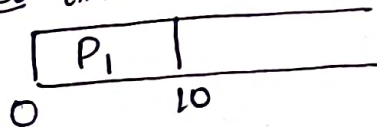
$$P_2 = 10 - 1 = 9$$

$$P_3 = 12 - 2 = 10$$

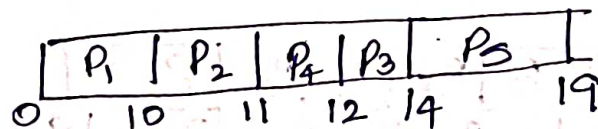
$$P_4 = 11 - 1 = 10$$

$$P_5 = 17 - 5 = 12$$

$$4\frac{1}{5} = 8.2$$

(ii) SJF :- @ time = 0

@ time = 10 \Rightarrow all processes are available, so pick lowest.

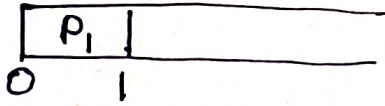


Since order is same as FCFS. Avg TAT and avg waiting time are same as a subdivision

$$(i) \text{ avg TAT} = 12 \quad \text{avg WT} = 8.2$$

(iii) SRTS:- also called as preemptive SJF.

@ time = 0



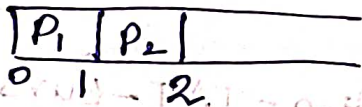
@ time = 1 ; left over burst time

$$P_1 = 10 - 1 = 9$$

$$P_2 = 1$$

$$P_4 = 1$$

} pick minimum
∴ P₂



@ time = 2

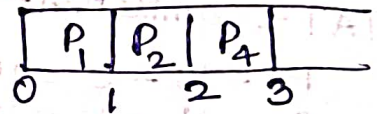
$$P_1 = 9$$

$$P_4 = 1$$

$$P_3 = 2$$

$$P_5 = 5$$

} minimum ⇒ P₄



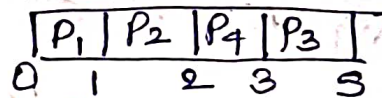
@ time = 3

$$P_1 = 9$$

$$P_3 = 2$$

$$P_5 = 5$$

} minimum ⇒ P₃

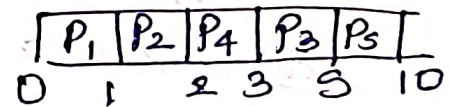


@ time = 5

$$P_1 = 9$$

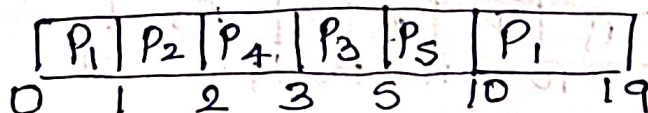
$$P_5 = 5$$

} minimum ⇒ P₅



@ time = 10

$$P_1 = 9$$



TAT = completion - arrival

$$\begin{array}{rcl}
 P_1 & \rightarrow & 19 - 0 = 19 \\
 P_2 & \rightarrow & 2 - 1 = 1 \\
 P_3 & \rightarrow & 5 - 2 = 3 \\
 P_4 & \rightarrow & 3 - 1 = 2 \\
 P_5 & \rightarrow & 10 - 2 = 8 \\
 \hline
 & & \frac{33}{5} = 6.6
 \end{array}$$

waiting = TAT - burst

$$\begin{array}{rcl}
 P_1 & \rightarrow & 19 - 10 = 9 \\
 P_2 & \rightarrow & 1 - 1 = 0 \\
 P_3 & \rightarrow & 3 - 2 = 1 \\
 P_4 & \rightarrow & 2 - 1 = 1 \\
 P_5 & \rightarrow & 8 - 5 = 3 \\
 \hline
 \text{Avg waiting} & \Rightarrow & \frac{14}{5} = 2.8
 \end{array}$$

(iv) Round robin time quantum = 2ms

② Follow order of arrival

$P_1 P_2 P_4 P_3 P_5$

P_1	P_2	P_4	P_3	P_5	P_1	P_5	P_1	P_5	P_1
0	2	3	4	6	8	10	12	14	15

TAT = completion - arrival

$$\begin{array}{rcl}
 P_1 & \rightarrow & 19 - 0 = 19 \\
 P_2 & \rightarrow & 3 - 1 = 2 \\
 P_3 & \rightarrow & 6 - 2 = 4 \\
 P_4 & \rightarrow & 4 - 1 = 3 \\
 P_5 & \rightarrow & 15 - 2 = 13 \\
 \hline
 \text{avg TAT} & = & \frac{41}{5} = 8.2
 \end{array}$$

WT = TAT - burst

$$\begin{array}{rcl}
 P_1 & = & 19 - 10 = 9 \\
 P_2 & = & 2 - 1 = 1 \\
 P_3 & = & 4 - 2 = 2 \\
 P_4 & = & 3 - 1 = 2 \\
 P_5 & = & 13 - 5 = 8 \\
 \hline
 \text{avg WT} & = & \frac{22}{5} = 4.4
 \end{array}$$

(iv) Priority \rightarrow non-preemptive.

P_1	P_2	P_5	P_3	P_4
0	10	11	16	18

TAT = completion - arrival

$$\begin{array}{rcl}
 P_1 & \rightarrow & 10 - 0 = 10 \\
 P_2 & \rightarrow & 11 - 1 = 10 \\
 P_3 & \rightarrow & 18 - 2 = 16 \\
 P_4 & \rightarrow & 19 - 1 = 18 \\
 P_5 & \rightarrow & 16 - 2 = 14 \\
 \hline
 \text{avg TAT} & = & \frac{68}{5} = 13.6
 \end{array}$$

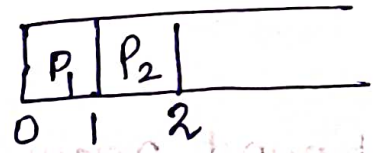
WT = TAT - burst

$$\begin{array}{rcl}
 P_1 & \rightarrow & 10 - 10 = 0 \\
 P_2 & \rightarrow & 10 - 1 = 9 \\
 P_3 & \rightarrow & 16 - 2 = 14 \\
 P_4 & \rightarrow & 18 - 1 = 17 \\
 P_5 & \rightarrow & 14 - 5 = 9 \\
 \hline
 \text{avg WT} & = & \frac{49}{5} = 9.8
 \end{array}$$

(v) Priority - preemptive.@ time = 0 only P_1 arrives

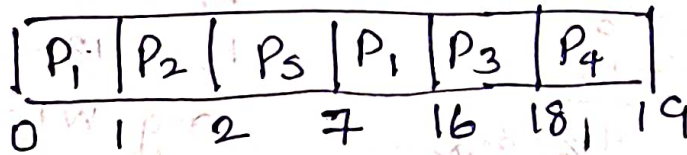
@ time = 1

	priority
P_1	3
P_2	1
P_4	4

Highest priority
 P_2 

@ time = 2

	priority
$P_1 \rightarrow$	3
$P_4 \rightarrow$	4
$P_3 \rightarrow$	3
$P_5 \rightarrow$	2

Highest priority
first
 $\therefore P_5, P_1, P_3, P_4$ 

TAT = completion - arrival

WT = TAT - burst

$$P_1 = 16 - 0 = 16$$

$$P_2 = 2 - 1 = 1$$

$$P_3 = 18 - 2 = 16$$

$$P_4 = 19 - 1 = 18$$

$$P_5 = 7 - 2 = 5$$

$$\text{avg TAT} = \frac{56}{5} = 11.2$$

$$P_1 = 16 - 10 = 6$$

$$P_2 = 1 - 1 = 0$$

$$P_3 = 16 - 2 = 14$$

$$P_4 = 18 - 1 = 17$$

$$P_5 = 5 - 5 = 0$$

$$\text{avg WT} = \frac{37}{5} = 7.4$$

_____ x _____ x _____ x _____