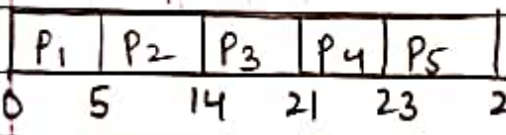
Ques 4 :-

Process	A.T	B.T
P_1	0	5
P_2	1	9
P_3	2	7
P_4	3	2
P_5	4	4

i) FCFS (First come first serve)
(Now Preemptive) :-



T.A.T = C.T - A.T	W.T = T.A.T - B.T	Normalized TA.T = TA.T/B.T
$P_1 \Rightarrow$ 5 - 0 = 5	$P_1 \Rightarrow$ 5 - 5 = 0	$P_1 \Rightarrow$ 5/5 = 1
$P_2 \Rightarrow$ 14 - 1 = 13	$P_2 \Rightarrow$ 13 - 9 = 4	$P_2 \Rightarrow$ 13/9 = 1.44
$P_3 \Rightarrow$ 21 - 2 = 19	$P_3 \Rightarrow$ 19 - 7 = 12	$P_3 \Rightarrow$ 19/7 = 2.71
$P_4 \Rightarrow$ 23 - 3 = 20	$P_4 \Rightarrow$ 20 - 2 = 18	$P_4 \Rightarrow$ 20/2 = 10
$P_5 \Rightarrow$ 27 - 4 = 23	$P_5 \Rightarrow$ 23 - 4 = 19	$P_5 \Rightarrow$ 23/4 = 5.75

I) Average T.A.T = $\frac{5+13+19+20+23}{5} = 16$

II) Average W.T. = $\frac{0+4+12+18+19}{5} = 10.6$

III) Average Normalized T.A.T = $\frac{1+1.44+2.71+10+5.75}{}$

Given

ii) Round Robbin (Time quantum = 5)

Process	B.T	A.T	Priority
P_1	8 30	0	1
P_2	20 15	1	3
P_3	8 0	2	2
P_4	8 1 0	3	5
P_5	12 7 2	4	4

$P_1\ P_2\ P_3\ P_4$

RQ :- $P_1\ P_2\ P_3\ P_4\ P_5\ P_1\ P_2\ P_4\ P_5\ P_2\ P_5\ P_2$

Gantt chart :-

P_1	P_2	P_3	P_4	P_5	P_1	P_2	P_4	P_5	P_2	P_5	P_2

0 5 10 13 18 23 26 31 32 37 42 44

T.A.T = C.T - A.T	W.T = T.A.T - B.T	Normalized T.A.T = TAT/BT
$P_1 \Rightarrow$ 26 - 0 = 26	$P_1 \Rightarrow$ 26 - 8 = 18	$P_1 \Rightarrow 26/8 = 3.25$
$P_2 \Rightarrow$ 49 - 1 = 48	$P_2 \Rightarrow$ 48 - 20 = 28	$P_2 \Rightarrow 48/20 = 2.4$
$P_3 \Rightarrow$ 13 - 2 = 11	$P_3 \Rightarrow$ 11 - 3 = 8	$P_3 \Rightarrow 11/3 = 3.66$
$P_4 \Rightarrow$ 32 - 3 = 29	$P_4 \Rightarrow$ 29 - 6 = 23	$P_4 \Rightarrow 29/6 = 4.83$
$P_5 \Rightarrow$ 44 - 4 = 40	$P_5 \Rightarrow$ 40 - 12 = 28	$P_5 \Rightarrow 40/12 = 3.33$

i) Average TAT $= \frac{26+48+11+29+40}{5} = 30.8$

ii) Average WT $= \frac{18+28+8+23+28}{5} = 21$

iii) Average Normalized TAT $= \frac{3.25+2.4+3.66+4.83+3.33}{5}$

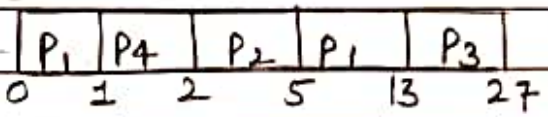
$= 3.49$

ii) SRN (With Preemptive):-

Process	A.T	B.T
P_1	0	9
P_2	1	3
P_3	1	14
P_4	1	1

$P_1 P_2 P_3 P_4$

Gantt chart :-



T.A.T = C.T - A.T	W.T = T.A.T - B.T	Normal. TAT = TAT/B.T.
$P_1 \Rightarrow$ 13 - 0 = 13	$P_1 \Rightarrow$ 13 - 9 = 4	$P_1 \Rightarrow$ 13/9 = 1.44
$P_2 \Rightarrow$ 5 - 1 = 4	$P_2 \Rightarrow$ 4 - 3 = 1	$P_2 \Rightarrow$ 4/3 = 1.33
$P_3 \Rightarrow$ 27 - 1 = 26	$P_3 \Rightarrow$ 26 - 14 = 12	$P_3 \Rightarrow$ 26/14 = 1.85
$P_4 \Rightarrow$ 2 - 1 = 1	$P_4 \Rightarrow$ 1 - 1 = 0	$P_4 \Rightarrow$ 1/1 = 1

I) Average T.A.T $\Rightarrow \frac{13+4+26+1}{4} = 11$

II) Average W.T $\Rightarrow \frac{4+1+12+0}{4} = 4.25$

III) Average Normalized TAT $\Rightarrow \frac{1.44+1.33+1.85+1}{4} = 1.40$

vi) Priority Scheduling (Preemptive) :-

Process	A.T	B.T	Priority
P1	0	8	1 (H)
P2	1	20	3
P3	2	3	2
P4	3	6	5 (L)
P5	4	12	4

P1 P2 P3 P4 P5

CP

P1	P1	P1	P1	P1	P1	P1	P1	P3	P3	P2	P2	P5	P4

0 1 2 3 4 5 6 7 8 9 10 11 31 43 49

T.A.T = C.T - A.T	W.T = T.A.T - B.T	Normalized TAT = TAT/BT
P1 ⇒ 8-0 = 8	P1 ⇒ 8-8 = 0	P1 ⇒ 8/8 = 1
P2 ⇒ 31-1 = 30	P2 ⇒ 30-20 = 10	P2 ⇒ 30/20 = 1.5
P3 ⇒ 11-2 = 9	P3 ⇒ 9-3 = 6	P3 ⇒ 9/3 = 3
P4 ⇒ 49-3 = 46	P4 ⇒ 46-6 = 40	P4 ⇒ 46/6 = 7.6
P5 ⇒ 43-4 = 39	P5 ⇒ 39-12 = 27	P5 ⇒ 39/12 = 3.25

i) Average TAT = $\frac{8+30+9+46+39}{5} = 26.4$

ii) Average WT = $\frac{0+10+6+40+27}{5} = 16.6$

iii) Normalized TAT = $\frac{1+1.5+3+7.6+3.25}{5}$

iv) SRF with preemptive :-

Process	A.T	B.T	Priority
P_1	0	8	1
P_2	1	20	3
P_3	2	3	2
P_4	3	6	5
P_5	4	12	4

~~P_1, P_2, P_3, P_4, P_5~~

P_1	P_1	P_3	P_3	P_1	P_4	P_5	P_2
0	1	2	3	5	11	17	29	49

T.A.T = C.T - A.T	W.T = T.A.T - B.T	Normalized TAT = TAT/BT
$P_1 \Rightarrow 11-0 = 11$	$P_1 \Rightarrow 11-8 = 3$	$P_1 \Rightarrow 11/8 = 1.37$
$P_2 \Rightarrow 49-1 = 48$	$P_2 \Rightarrow 48-20 = 28$	$P_2 \Rightarrow 48/20 = 2.4$
$P_3 \Rightarrow 5-2 = 3$	$P_3 \Rightarrow 3-3 = 0$	$P_3 \Rightarrow 3/3 = 1$
$P_4 \Rightarrow 17-3 = 14$	$P_4 \Rightarrow 14-6 = 8$	$P_4 \Rightarrow 14/6 = 2.33$
$P_5 \Rightarrow 29-4 = 25$	$P_5 \Rightarrow 25-12 = 13$	$P_5 \Rightarrow 25/12 = 2.08$

i) Average T.A.T = $\frac{11+48+3+14+25}{5} = 20.2$

ii) Average W.T = $\frac{3+28+0+8+13}{5} = 10.4$

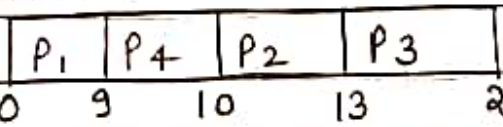
(iii) Average Normalized TAT = $\frac{1.37+2.4+1+2.33+2.08}{5} = 1.83$

Ques 6 :-

Process	Arrival Time	Brust Time
P_1	0	9
P_2	1	3
P_3	1	14
P_4	1	1

i) SPN (Shortest Process Next)
(Non-Preemptive)

Gantt chart



T·A·T = C·T - A·T	W·T = T·A·T - B·T	Normalized T·A·T = T·AT/BT
$P_1 \Rightarrow 9-0=9$	$P_1 \Rightarrow 9-9=0$	$P_1 \Rightarrow 9/9 = 1$
$P_2 \Rightarrow 13-1=12$	$P_2 \Rightarrow 12-3=9$	$P_2 \Rightarrow 12/3 = 4$
$P_3 \Rightarrow 27-1=26$	$P_3 \Rightarrow 26-14=12$	$P_3 \Rightarrow 26/14 = 1.85$
$P_4 \Rightarrow 10-1=9$	$P_4 \Rightarrow 9-1=8$	$P_4 \Rightarrow 9/1 = 9$

I) Average T·A·T $\Rightarrow \frac{9+12+26+9}{4} = 14$

II) Average WT $\Rightarrow \frac{0+9+12+8}{4} = 7.25$

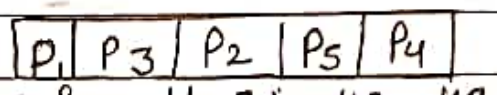
III) Average Normalized T·A·T $\Rightarrow \frac{1+4+1.85+9}{4} = 3.96$

v) Priority Scheduling (Non-Preemptive) :-

(1 mean highest Priority)

Process	A.T	B.T	Priority
P_1	0	8	1 (H)
P_2	1	20	3
P_3	2	3	2
P_4	3	6	5 (L)
P_5	4	12	4

Gantt chart



T.A.T = C.T - A.T	W.T = T.A.T - B.T	Normalized TAT = TAT/BT
$P_1 \Rightarrow$ 8 - 0 = 8	$P_1 \Rightarrow$ 8 - 8 = 0	$P_1 \Rightarrow$ 8/8 = 1
$P_2 \Rightarrow$ 31 - 1 = 30	$P_2 \Rightarrow$ 30 - 20 = 10	$P_2 \Rightarrow$ 30/20 = 1.5
$P_3 \Rightarrow$ 11 - 2 = 9	$P_3 \Rightarrow$ 9 - 3 = 6	$P_3 \Rightarrow$ 9/3 = 3
$P_4 \Rightarrow$ 49 - 3 = 46	$P_4 \Rightarrow$ 46 - 6 = 40	$P_4 \Rightarrow$ 46/6 = 7.6
$P_5 \Rightarrow$ 43 - 4 = 39	$P_5 \Rightarrow$ 39 - 12 = 27	$P_5 \Rightarrow$ 39/12 = 3.25

i) Average T.A.T $\Rightarrow \frac{8+30+9+46+39}{5} = 26.4$

ii) Average W.T $= \frac{0+10+6+40+27}{5} = 16.6$

iii) Average Normalized TAT $= \frac{1+1.5+3+7.6+3.25}{5}$

$= 3.21$

Ques 7)

Ans :

Process	A.T	B.T
P_1	0	9
P_2	1	1
P_3	2	7
P_4	3	1
P_5	4	6

i) FCFS (First come first serve)

Non-preemptive :-

P_1	P_2	P_3	P_4	P_5

0 9 10 17 18 24

	T.A.T = C.T - A.T	W.T = T.A.T - B.T	Normalized T.A.T = T.A.T / B.T
$P_1 \Rightarrow$	$9 - 0 = 9$	$P_1 \Rightarrow 9 - 9 = 0$	$P_1 \Rightarrow 9/9 = 1$
$P_2 \Rightarrow$	$10 - 1 = 9$	$P_2 \Rightarrow 9 - 1 = 8$	$P_2 \Rightarrow 9/1 = 9$
$P_3 \Rightarrow$	$17 - 2 = 15$	$P_3 \Rightarrow 15 - 7 = 8$	$P_3 \Rightarrow 15/7 = 2.14$
$P_4 \Rightarrow$	$18 - 3 = 15$	$P_4 \Rightarrow 15 - 1 = 16$	$P_4 \Rightarrow 15/1 = 15$
$P_5 \Rightarrow$	$24 - 4 = 20$	$P_5 \Rightarrow 20 - 6 = 14$	$P_5 \Rightarrow 20/6 = 3.33$

Average T.A.T $\Rightarrow \frac{9+9+15+15+20}{5} = 13.6$

Average W.T $\Rightarrow \frac{0+8+8+16+14}{5} = 9.2$

Average Normalized T.A.T $\Rightarrow \frac{1+9+2.14+15+3.33}{5}$

(iii) SRJF (with preemptive) :-

Process	A.T	B.T
P_1	0	5
P_2	1	9
P_3	2	7
P_4	3	2
P_5	4	4

Gantt chart :-

P_1	P_4	P_5	P_3	P_2
0	5	7	11	18	27

T.A.T = C.T - B.T	W.T = T.A.T - B.T	Normalized T.A.T = T.AT/B.T
$P_1 \Rightarrow$ 5-0 = 5	$P_1 \Rightarrow$ 5-5 = 0	$P_1 \Rightarrow$ 5/5 = 1
$P_2 \Rightarrow$ 27-1 = 26	$P_2 \Rightarrow$ 26-9 = 17	$P_2 \Rightarrow$ 26/9 = 2.88
$P_3 \Rightarrow$ 18-2 = 16	$P_3 \Rightarrow$ 16-7 = 9	$P_3 \Rightarrow$ 16/7 = 2.28
$P_4 \Rightarrow$ 7-3 = 4	$P_4 \Rightarrow$ 4-2 = 2	$P_4 \Rightarrow$ 4/2 = 2
$P_5 \Rightarrow$ 11-4 = 7	$P_5 \Rightarrow$ 7-4 = 3	$P_5 \Rightarrow$ 7/4 = 1.75

I) Average T.A.T = $\frac{5+26+16+4+7}{5}$ = 11.6

II) Average W.T = $\frac{0+17+9+2+3}{5}$ = 6.2

III) Average Nor. T.A.T = $\frac{1+2.88+2.28+2+1.75}{5}$

$P_3 \Rightarrow 16-4=12$ | $P_4 \Rightarrow 12-6=6$ | $P_5 \Rightarrow$

Average T.A.T $= \frac{24+1+8+1+12}{5} = 9.2$

Average W.T $= \frac{15+0+1+0+6}{5} = 4.4$

Average Normalized T.A.T $= \frac{2.66+1+1.14+1+2}{5} = 1.56$

iii) SJF with non-preemptive :-

Date __/__/____

Process	A.T	B.T
P_1	0	9
P_2	1	1
P3	2	7
P4	3	1
P_5	4	6

Gantt chart

P_1	P_2	P4	P_5	P3

0 9 10 11 17 24

T.A.T = C.T - A.T	W.T = T.A.T - B.T	Normalized TAT = TAT/BT
$P_1 \Rightarrow 9-0=9$	$P_1 \Rightarrow 9-9=0$	$P_1 \Rightarrow 9/9=1$
$P_2 \Rightarrow 10-1=9$	$P_2 \Rightarrow 9-1=8$	$P_2 \Rightarrow 9/1=9$
$P_3 \Rightarrow 24-2=22$	$P_3 \Rightarrow 22-7=15$	$P_3 \Rightarrow 22/7=3.14$
$P_4 \Rightarrow 11-3=8$	$P_4 \Rightarrow 8-1=7$	$P_4 \Rightarrow 8/1=8$
$P_5 \Rightarrow 17-4=13$	$P_5 \Rightarrow 13-6=7$	$P_5 \Rightarrow 13/6=2.16$

Average T.A.T $\Rightarrow \frac{9+9+22+8+13}{5} = 12.2$

Average W.T $\Rightarrow \frac{0+8+15+7+7}{5} = 7.4$

Average Normalized TAT $\Rightarrow \frac{1+9+3.14+8+2.16}{5} = 4.66$

Ques 5 :-

Process	BT	AT	Priority
P1	8	0	1
P2	20	1	3
P3	3	2	2
P4	6	3	5
P5	12	4	4

- 1 means highest priority
- Time Quantum = 5

i) FCFS (Non-Preemptive) :-

P1	P2	P3	P4	P5

0 8 28 31 37 49

T.A.T = C.T - A.T	W.T = T.A.T - B.T	Normalized T.A.T = TAT/BT
P1 => 8 - 0 = 8	P1 => 8 - 8 = 0	P1 => 8/8 = 1
P2 => 28 - 1 = 27	P2 => 27 - 20 = 7	P2 => 27/20 = 1.35
P3 => 31 - 2 = 29	P3 => 29 - 3 = 26	P3 => 29/3 = 9.66
P4 => 37 - 3 = 34	P4 => 34 - 6 = 28	P4 => 34/6 = 5.66
P5 => 49 - 4 = 45	P5 => 45 - 12 = 33	P5 => 45/12 = 3.75

i) Average T.A.T = $\frac{8+27+29+34+45}{5} = 28.6$

ii) Average WT = $\frac{0+7+26+28+33}{5} = 32.8$

iii) Average Normalized TAT = $\frac{1+1.35+9.66+5.66+3.75}{5}$

= 4.28

Date / /

Page No.

Ans 1 :- SRN (Shortest Remaining Next) Scheduling not be used directly in practices because it require accurate estimate of the runtime(BT) of each process.

(iii) SJF with non-preemptive (without Priority):-

Process	AT	BT	Priority
P_1	0	8	1
P_2	1	20	3
P_3	2	3	2
P_4	3	6	5
P_5	4	12	4

⇒

P_1	P_3	P_4	P_5	P_2
0	8	11	17	29	49

T.A.T = C.T - A.T	W.T = T.A.T - B.T	Normalized TAT = TAT/BT
P_1 ⇒ 8 - 0 = 8	P_1 ⇒ 8 - 8 = 0	P_1 ⇒ 8/8 = 1
P_2 ⇒ 49 - 1 = 48	P_2 ⇒ 48 - 20 = 28	P_2 ⇒ 48/20 = 2.4
P_3 ⇒ 11 - 2 = 9	P_3 ⇒ 9 - 3 = 6	P_3 ⇒ 9/3 = 3
P_4 ⇒ 17 - 3 = 14	P_4 ⇒ 14 - 6 = 8	P_4 ⇒ 14/6 = 2.33
P_5 ⇒ 29 - 4 = 25	P_5 ⇒ 25 - 12 = 13	P_5 ⇒ 25/12 = 2.08

i) Average T.A.T = $\frac{8+48+9+14+25}{5}$ → 20.8

ii) Average W.T = $\frac{0+28+6+8+13}{5}$ = 11

(iii) Normalized T.A.T = $\frac{1+2.4+3+2.33+2.08}{5}$

= 10.81

iv) SJF (with non- preemptive):-

Process	A.T	B.T
P_1	0	5
P_2	1	9
P_3	2	7
P_4	3	2
P_5	4	4

Gantt chart :-

P_1	P_4	P_5	P_3	P_2
0	5	7	11	18	27

T.A.T = C.T - A.T	W.T = T.A.T - B.T	Normali TAT = TAT/BT
$P_1 \Rightarrow$ 5-0 = 5	$P_1 \Rightarrow$ 5-5 = 0	$P_1 \Rightarrow$ 5/5 = 1
$P_2 \Rightarrow$ 27-1 = 26	$P_2 \Rightarrow$ 26-9 = 17	$P_2 \Rightarrow$ 26/9 = 2.88
$P_3 \Rightarrow$ 18-2 = 16	$P_3 \Rightarrow$ 16-7 = 9	$P_3 \Rightarrow$ 16/7 = 2.28
$P_4 \Rightarrow$ 7-3 = 4	$P_4 \Rightarrow$ 4-2 = 2	$P_4 \Rightarrow$ 4/2 = 2
$P_5 \Rightarrow$ 11-4 = 7	$P_5 \Rightarrow$ 7-4 = 3	$P_5 \Rightarrow$ 7/4 = 1.75

I) Average T.A.T $\Rightarrow \frac{5+26+16+4+7}{5} = 11.6$

II) Average W.T $\Rightarrow \frac{0+17+9+2+3}{5} = 6.2$

III) Average Normalize T.A.T $= \frac{1+2.88+2.28+2+1.75}{5}$

7)

ii) Round Robbin :-

Process	A.T	B.T
P_1	0	9
P_2	1	1
P_3	2	7
P_4	3	1
P_5	4	6

Ready Queue :- P_1 P_2 P_3 P_1 P_4 P_5 P_3 P_1 P_5 P_3 P_1 P_5 P_3 P_1

Gantt chart :-

P_1	P_2	P_3	P_1	P_4	P_5	P_3	P_1	P_5	P_3	P_1	P_5	P_3	P_1
0	2	3	5	7	8	10	12	14	16	18	20	22	23 24

T.A.T = C.T - A.T	W.T = T.A.T - B.T	Normalized T.A.T = TAT/BT
$P_1 \Rightarrow$ 24 - 0 = 24	$P_1 \Rightarrow$ 24 - 9 = 15	$P_1 \Rightarrow$ 24/9 = 2.66
$P_2 \Rightarrow$ 3 - 1 = 2	$P_2 \Rightarrow$ 2 - 1 = 1	$P_2 \Rightarrow$ 2/1 = 2
$P_3 \Rightarrow$ 23 - 7 = 16	$P_3 \Rightarrow$ 16 - 7 = 9	$P_3 \Rightarrow$ 16/7 = 2.28
$P_4 \Rightarrow$ 8 - 3 = 5	$P_4 \Rightarrow$ 5 - 1 = 4	$P_4 \Rightarrow$ 5/1 = 5
$P_5 \Rightarrow$ 22 - 4 = 18	$P_5 \Rightarrow$ 18 - 6 = 12	$P_5 \Rightarrow$ 18/6 = 3

I) Average TAT $= \frac{24+2+16+5+18}{5} = 13$

II) Average W.T $= \frac{15+1+9+4+12}{5} = 8.2$

III) Average Normalized T.A.T $= \frac{2.66+2+2.28+5+3}{5} = 3.10$