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Level : 2LMD	**Date: April 2024**	**Module** : Operating Systems 1

Series 3: Process scheduling (Solution)

Exercise 1

Process	Arrival time	CPU Burst
P1	0	3
P2	2	6
P3	4	4
P4	6	5
P5	8	2

- **Turnaround Time (T.A.T):** Time Difference between completion time and arrival time.

  Turn Around Time = Completion Time – Arrival Time
- **Waiting Time (W.T):** Time Difference between turnaround time and burst time.

  Waiting Time = Turnaround Time – Burst Time
- CPU usage rate= sum of burst time of all pr / effective total execution time (get it from the chart)

1) FCFS :

P1	P2	P3	P4	P5

0 **P2**↑2 3 **P3**↑4 **P4**↑6 **P5**↑8 9 13 18 20

TAT (P1)=3-0=3 TAT (P2)=9-2=7 TAT (P3)=13-4=9 TAT (P4)=18-6=12 TAT (P5)=20-8=12	WT(P1)=3-3=0 WT(P2)=1 WT(P3)=5 WT(P4)=7 WT(P5)=10
Average TAT=3+7+9+12+12/5=8.6	Average WT=3+1+5+7+10/5=4.6

CPU usage rate= 20/20=100%

2) SJF: Shortest Job First.

P1	P2	P5	P3	P4

0 **P2**↑2 3 **P3**↑4 **P4**↑6 **P5**↑8 9 11 15 20

TAT (P1)=3-0=3 TAT (P2)=7 TAT (P3)=11 TAT (P4)=14 TAT (P5)=3	WT(P1)=3-3=0 WT(P2)=1 WT(P3)=7 WT(P4)=9 WT(P5)=1
Average TAT=7.6	Average WT=3.6

CPU usage rate= 20/20=100%

3) SRTF: Shortest remained Time First.

P1	P2	P3	P5	P2	P4

0 **P2**↑2 3 **P3** 4 **P4**↑6 **P5**↑ 8 10 15 20

TAT (P1)=3-0=3	WT(P1)=3-3=0
TAT (P2)=13	WT(P2)=7
TAT (P3)=4	WT(P3)=0
TAT (P4)=14	WT(P4)=9
TAT (P5)=2	WT(P5)=0
Average TAT=7.2	Average WT=3.2

CPU usage rate= 20/20=100%

4) RR: Round Robin (quantum = 4 units).

P1	P2	P3	P4	P2	P5	P4

0 **P2**↑2 3 **P3**↑4 **P4**↑6 7 P5↑8 11 15 17 19 20

TAT (P1)=3-0=3	WT(P1)=3-3=0
TAT (P2)=15	WT(P2)=9
TAT (P3)=7	WT(P3)=3
TAT (P4)=14	WT(P4)=9
TAT (P5)=11	WT(P5)=9
Average TAT=10	Average WT=6

CPU usage rate= 20/20=100%

Exercise 2

Process	Burst	Priority	Arrival Time
P_1	8	4	0
P_2	6	1	2
P_3	1	2	2
P_4	9	2	1
P_5	3	3	3

The highest priority= lowest number

I) Non-Preemptive Priority

P1	P2	P4	P3	P5

0 **P4**↑1 **P2**↑ **P3** ↑2 P5↑3 8 14 23 24 27

AVG. TAT = 8+14-2+24-2+23-1+27-3 = 8+12+22+22+24=17.6ms

Avg.Wait=8-8+12-6+22-1+22-9+24-3 = 0+6+21+13+21 =12.2ms

II) Preemptive Priority

P1	P4	P2	P4	P3	P5	P1

0 **P4**↑1 **P2**↑**P3**↑ 2 **P5**↑3 8 16 17 20 27

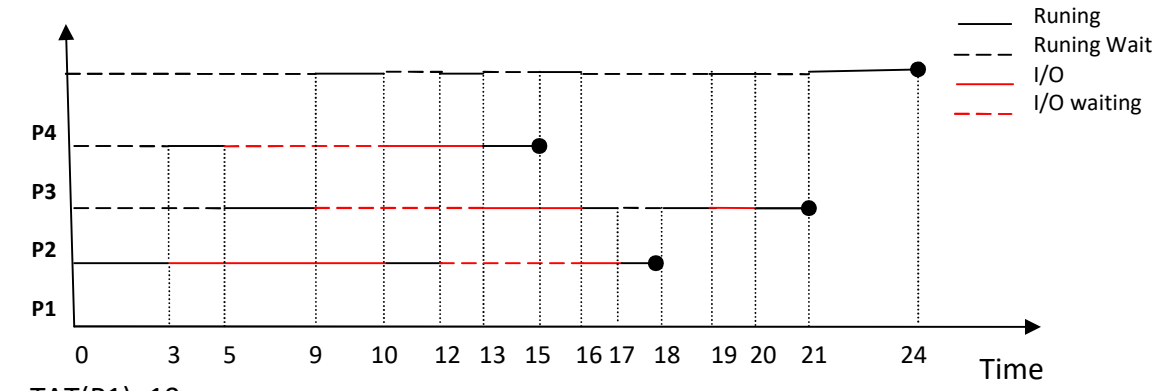
Avg. TAT = 27+8-2+17-2+16-1+20-3 = 16ms
Avg.Wait Time= 27-8+6-6+15-1+15-9+17-3 = 19+0+14+6+14 = 10.6ms

Exercise 3

1)priority (P1) > priority (P3) > priority (P2) > priority (P4)

Execution diagram

process



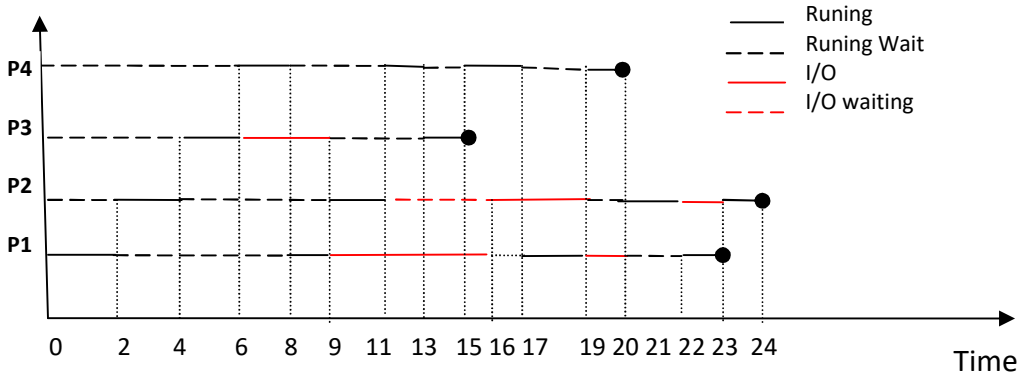
TAT(P1)=19
TAT(P2)=21
TAT(P3)=15
TAT(P4)=24
Average TAT=(19+21+15+24)/4=19.75
2) Round Robin (Q=2)

P1/	P2/	P3/	P4/	P1/i/o	P2/i/o	P4	P3	P4	P1	P4	P2	P1	P2	

Ready queue

	P1	P2	P3	P4
CPU Burst	3	4	2	7
I/O	7	3	3	
CPU Burst	2	2	2	
I/O	1	1		
CPU Burst	1	1		

process



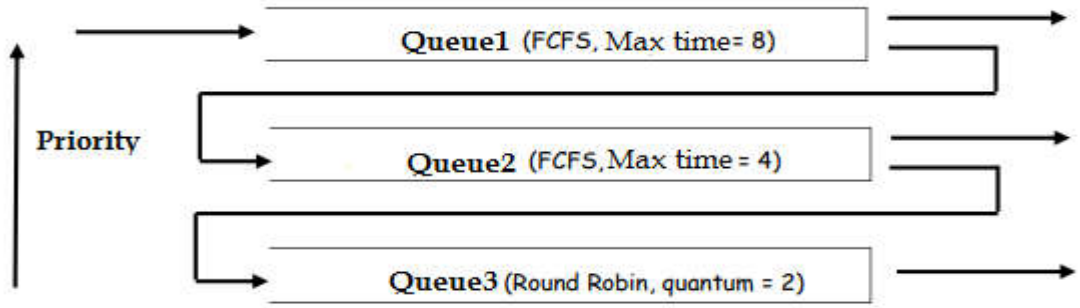
TAT(P1)=23
TAT(P2)=24
TAT(P3)=15
TAT(P4)=20

Average TAT=(23+24+15+20)/4=20.5
Priority scheduling gives the best average TAT than RR scheduling.

Exercise 4

1- Scheduling with multilevel feedback queues allows processes to move between queues. The idea comes down to separating the processes according to the evolution of their characteristics in the system.

2-



Process	Arrival time	Burst	Queque1	Queque2	Queque3
P1	0	16	8	4	2
P2	0	14	6	2	/
P3	0	10	2	/	/
P4	0	20	12	8	6
P5	0	6	/	/	/

P1	P2	P3	P4	P5	P1	P2	P3	P4	P1	P2	P4	P1	P4	P4	P4
0 8	16	24	32	38	42	46	48	52	54	56	58	60	62	64	66