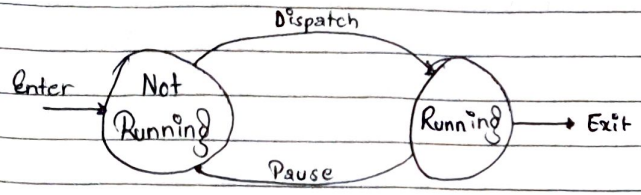
Assignment - 2

① Define process. Explain the process model along with the transition.

Ans. A process is defined as an entity which represents the basic unit of work to be implemented in the system i.e. a process is a program in execution. There are two types of process models:

i) Two state model:



State transition diagram

The two states are:

State 1: Process is running on CPU

State 2: Process is "Not Running" on CPU

New: First of all, when a new process is created, then it is in Not Running State. Suppose a new process P2 is created then P2 is in NOT Running state

CPU: When CPU becomes free, Dispatcher gives control of the CPU to P2 that is in NOT Running state & waiting in queue.

Dispatcher: Dispatcher is a ~~person~~ program that gives control of CPU to the process selected by the CPU schedules.

Running: When dispatcher allocas P2 to execute on CPU then P2 starts its execution.

ii) Five state model

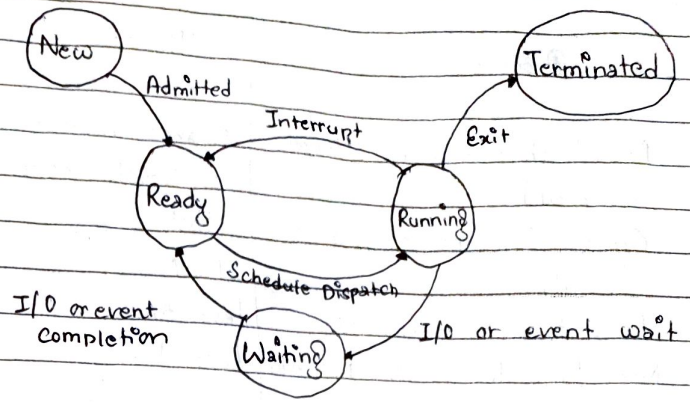


Fig: Five state model.

The five states are:

1. New: A process that has just been created but has not yet been admitted to the pool of executable process by the OS.
2. Ready: Process that is prepared to execute when given the opportunity. That is, they are not waiting on anything except the CPU availability.
3. Running: The process that is currently being executed
4. Blocked (Waiting): A process that cannot execute until some event occurs.
5. Exit: A process that has been released from the pool of executable processes by the OS.

(2) Differentiate between process & thread:

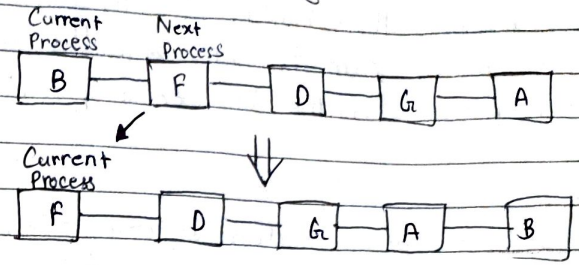
	Process	Thread
1.	Doesn't share memory (Loosely coupled)	Shares memories and files (Tightly coupled)
2.	Creation is time consuming.	Fast.
3.	Execution slow	Fast.
4.	More time to terminate	less time.
5.	More time to switch between process	less time
6.	System calls are required for communication	Not required.
7.	More resources are required.	Fewer resources are required.
8.	Not suitable for parallelism	Suitable for parallelism

(3) What is context switching? Explain the processes with example.

Ans: Context switching:

A context switching is the mechanism to store and restore the state or context of a CPU in process control block so that a process execution can be resumed from the same point at a later time.

Using this technique, a context switcher enables multiple processes to share a single CPU. When the scheduler switches the CPU from executing one process to execute another, the state from the current process is stored into its control block. After this, the state for the process to run next is loaded from its own PCB and used to set the PC, registers, etc. At that point, the second process can start executing.



(4) Differentiate between user-level thread and kernel-level thread:

	User-level thread	Kernel-level thread
1.	User-level threads are faster to create and manage.	Kernel-level threads are slower to create and manage.
2.	Implementation is by a thread library at the user-level.	Operating system supports creation of Kernel threads.
3.	User-level thread is generic & can run on any OS.	Kernel-level thread is specific to the OS.
4.	Multi-threaded applications can't take advantage of multiprocessing.	Kernel routines themselves can be multithreaded.

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(5.) Define scheduling. Explain scheduler & its types. Define dispatcher.

Ans: Scheduling:

The process scheduling is the activity of the process manager that handles the removal of the running process from the CPU and the selection of another process on the basis of a particular strategy.

Scheduler:

It is a special system software which handle process scheduling in various ways. Their main task is to select the jobs to be submitted into the system & to decide which process to run.

There are three types of scheduler:

- Long term scheduler
- Mid term schedules
- Short term schedules.

1. Long Term Scheduler:

The long term scheduler basically decides the priority in which processes must be placed in main memory. Processes of long term scheduler are placed in the ready state because in this state the process is ready to execute waiting for calls of execution from CPU which takes time that's why this is known as long-term schedule.

Mid Term Scheduler:

It places the blocked and suspended processes in the secondary memory of a computer system.

3. Short Term Scheduler:

It decides the priority in which processes is in the ready queue are allocated the CPU time for their execution.

Dispatcher:

Dispatcher is the module that gives control of the CPU to the process selected by the short time scheduler (selects from among the processes that are ready to execute).

(6.) Define the following terms:

a. CPU utilization

Keeping the CPU as busy as possible. Theoretically, it's value ranges from 0% to 100% but in practice, it is 40% to 90%.

b. Throughput:

Throughput is the rate at which processes are completed per unit of time.

c. Turnaround time:

It is the time taken by a process to execute. It is the difference between the completion time and the submission time.

d. Waiting time:

It is the sum of the time period spent waiting in queue

e. Response time:

It is the time taken to start responding from submission time.

(7) f) Burst time
The duration for which a process gets control of the CPU is burst time.

(7) Differentiate between preemptive & non-preemptive scheduling.

Ans:

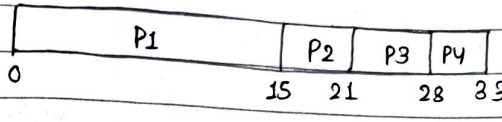
	Preemptive Scheduling	Non-preemptive scheduling
1.	The resources are allocated to a process for a limited time	Once resources are allocated to a process, the process holds it till it completes its burst time or switches to waiting state.
2.	Process can be interrupted in between.	Process cannot be interrupted till it terminates or switches to waiting state.
3.	Preemptive scheduling has overheads of scheduling the process.	It does not have overheads
4.	It is flexible.	It is rigid.

(8) Calculate the Average Turnaround Time & Average Waiting Time for following.
Using: FCFS, SJN, SRTN, Priority, Round-Robin, HRRN
Quantum = 2

(a) First Come First Serve (FCFS)

Process	Arrival Time	Burst time
P1	0	15
P2	2	6
P3	3	7
P4	5	5

i) FCFS:
Gantt Chart



Process	Arrival Time (AT)	Burst Time (BT)	Finish Time (FT)	Turnaround Time (TAT)	Waiting Time (WT)
P1	0	15	15	15	0
P2	2	6	21	19	13
P3	3	7	28	25	18
P4	5	5	33	28	23

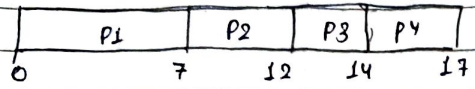
∴ Average Turnaround Time $(\overline{TAT}) = \frac{15+19+25+28}{4} = 21.75$

Average Waiting Time $(\overline{WT}) = \frac{0+13+18+23}{4} = 13.5$ //

(b)

Process	AT	BT
P1	0	7
P2	1	5
P3	3	2
P4	4	3

Gantt Chart:



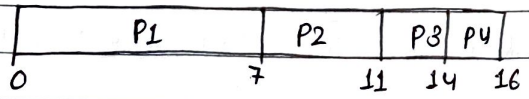
Process	AT	BT	FT	TAT	WT
P1	0	7	7	7	0
P2	1	5	12	11	6
P3	3	2	14	11	9
P4	4	3	17	13	10

∴ Average Turnaround Time = $(7+11+11+13)/4 = 10.5$ ■
Average Waiting Time = $(0+6+9+10)/4 = 6.25$ //

(c)

Process	AT	BT
P1	0	7
P2	1	4
P3	3	3
P4	4	2

⇒ Gantt Chart:



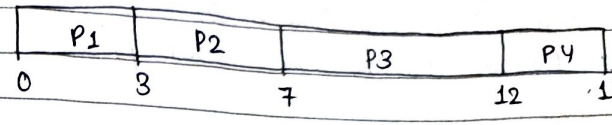
Process	AT	BT	FT	TAT	WT
P1	0	7	7	7	0
P2	1	4	11	10	6
P3	3	3	14	11	8
P4	4	2	16	12	10

∴ $\overline{TAT} = 10$
$\overline{WT} = 6$ //

(d)

Process	AT	BT
P1	0	3
P2	2	4
P3	3	5
P4	4	2

⇒ Gantt Chart:



Process	AT	BT	FT	TAT	WT
P1	0	3	3	3	0
P2	2	4	7	5	1
P3	3	5	12	9	4
P4	4	2	14	10	8

∴ Average Turnaround Time = $\frac{3+5+9+10}{4} = 6.75$

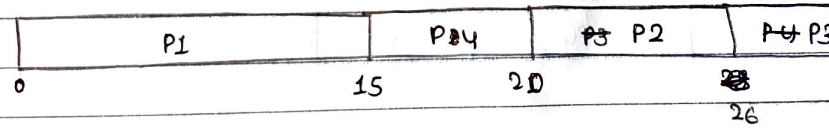
Average Waiting Time = $\frac{0+1+4+8}{4} = 3.25$ //

★ Shortest Job Next (SJN):

(a)

Process	Arrival Time	Burst Time
P1	0	15
P2	2	6
P3	3	7
P4	5	5

⇒ Gantt Chart:



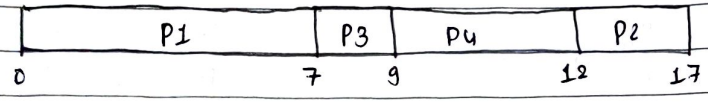
Process	AT	BT	FT	TAT	WT
P1	0	15	15	15	0
P2	2	6	26	24	18
P3	3	7	33	30	23
P4	5	5	20	15	10

∴ Average Turnaround Time = 21

Average Waiting Time = 12.75 //

(b) Here,

Gantt Chart:



Process	AT	BT	FT	TAT	WT
P1	0	7	7	7	0
P2	1	5	17	16	11
P3	2	2	9	7	5
P4	3	3	12	9	6

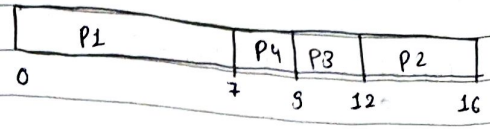
∴ Average Turnaround Time ($\overline{TAT}$) = (7+16+7+9)/4 = 9.75

Average Waiting Time ($\overline{WT}$) = (0+11+5+6)/4 = 5.5 //

(c)

Process	AT	BT
P1	0	7
P2	1	4
P3	3	3
P4	4	2

Gantt Chart:



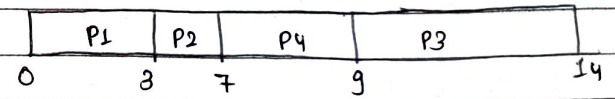
Process	Arrival Time (AT)	Burst Time (BT)	Finish Time (FT)	TAT	WT
P1	0	7	7	7	0
P2	1	4	16	15	11
P3	3	3	12	9	6
P4	4	2	9	5	3

∴ Average Turnaround Time ($\overline{TAT}$) = (7+15+9+5)/4 = 9

Average Waiting Time ($\overline{WT}$) = (0+11+6+3)/4 = 5 //

(d) Here,

Gantt Chart:



Process	AT	BT	FT	TAT	WT
P1	0	3	3	3	0
P2	2	4	7	5	1
P3	3	5	9	6	1
P4	4	2	14	10	8

∴ Average Turnaround Time = $\frac{3+5+6+10}{4}$ = 6

Average Waiting Time = $\frac{0+1+1+8}{4}$ = 2.5 //

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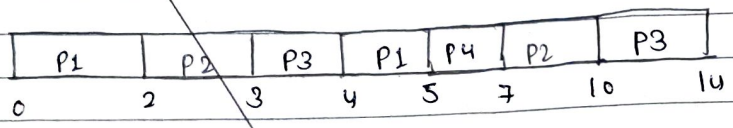
④

Process	Arrival Time	Burst Time	
P1	0	3	1
P2	2	4	3
P3	3	5	4
P4	4	2	2

⇒ Gantt Chart:



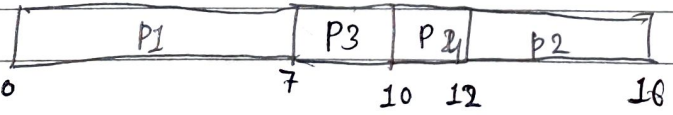
Process	AT	BT	FT	TAT	WT
P1	0	3	5	5	2
P2	2	4	10	8	4
P3	3	5	14	11	6
P4	4	2	7	3	1

∴ Average TAT = 6.75
Average WT = 4.25 //

★ Priority Scheduling:

Process	AT	BT	Priority
P1	0	7	4
P2	1	4	3
P3	3	3	1 (High)
P4	4	2	2

⇒ Gantt Chart:



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Process	AT	BT	FT	TAT	WT
P1	0	7	7	7	0
P2	1	4	16	15	11
P3	3	3	10	7	4
P4	4	2	12	8	6

∴ Average TAT = 9.25
Average WT = 5.25 //

★ Round Robin Scheduling:

⑤

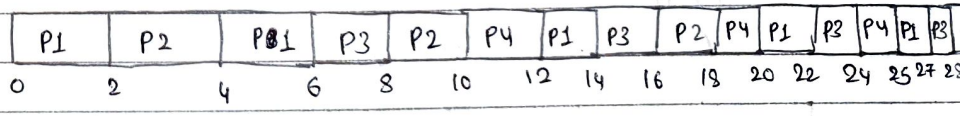
Process	Arrival Time	Burst Time
P1	0	15
P2	2	6
P3	3	7
P4	5	5

Quantum = 2ms

⇒ Queue:

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

Chart:



Process	AT	BT	FT	TAT	WT
P1	0	15	33	33	18
P2	2	6	18	16	14
P3	3	7	28	25	18
P4	5	5	25	20	15

∴ $\overline{TAT}$ = 23.5

$\overline{WT}$ = 16.25 //

(b)

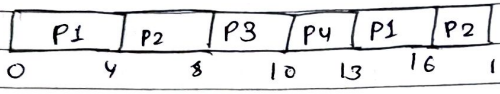
Process	AT	BT
P1	0	7
P2	1	5
P3	3	2
P4	4	3

Quantum = 4 sec

Queue:

~~P1 P2 P3 P4 P1~~ P2

Chart:



Process	AT	BT	FT	TAT	WT
P1	0	7	16	16	9
P2	1	5	17	16	11
P3	3	2	10	7	5
P4	4	3	13	9	6

∴ Average TAT = 12

Average WT = 7.75 //

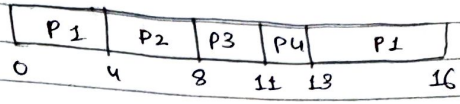
Process	AT	BT
P1	0	7
P2	1	4
P3	3	3
P4	4	2

Quantum = 4.

Queue:

~~P1~~ P2 ~~P3~~ ~~P4~~ ~~P1~~

Chart:



Process	AT	BT	FT	TAT	WT
P1	0	7	16	16	9
P2	1	4	8	7	3
P3	3	3	11	8	5
P4	4	2	13	9	7

∴ Average TAT = 10

Average WT = 6 //

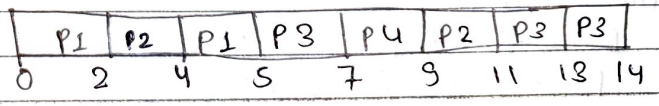
(d)

Process	AT	BT
P1	0	3
P2	2	4
P3	3	5
P4	4	2

Quantum = 2.

Queue: ~~P1 P2 P1 P3 P4 P2 P3~~

Chart:



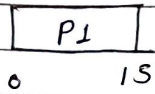
Process	AT	BT	FT	TAT	WT
P1	0	3	5	5	2
P2	2	4	11	9	5
P3	3	5	14	11	6
P4	4	2	9	5	3

∴ Average TAT = 7.5
Average WT = 4 //

★ HRRN

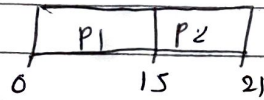
(a)

Process	AT	BT
P1	0	15
P2	2	6
P3	3	7
P4	5	5



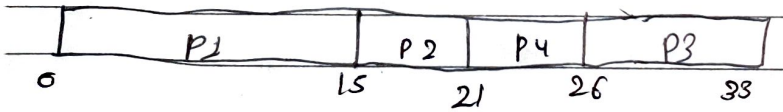
Response Ratio:

P2 = (13+6)/6 = 3.166
P3 = (12+7)/6 = 2.714
P4 = (10+5)/5 = 3



Response Ratio:

P3 = (18+7)/7 = 3.571
P4 = (16+5)/5 = 4.2



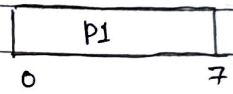
Process	AT	BT	FT	TAT	WT
P1	0	15	15	15	0
P2	2	6	21	19	13
P3	3	7	33	30	23
P4	5	5	26	21	16

∴ Average TAT = 21.25
Average WT = 13.75

(b)

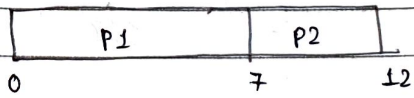
Process	AT	BT
P1	0	7
P2	1	5
P3	3	2
P4	4	3

Chart:



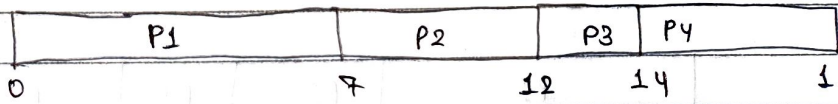
Response Ratio:

P2 = ((7-1)+5)/5 = 5.5
P3 = ((7-3)+2)/2 = 3
P4 = ((7-4)+3)/3 = 2



Response Ratio:

P3 = (9+2)/2 = 5.5 ; P4 = (8+3)/2 = 5.5



Process	AT	BT	FT	TAT	WT
P1	0	7	7	7	0
P2	1	5	12	11	6
P3	3	2	14	11	9
P4	4	3	17	13	10

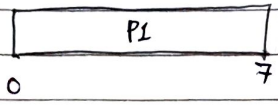
∴ Average TAT = (7+11+11+13)/4 = 10.5

Average WT = (0+6+9+10)/4 = 6.25 //

(c)

Process	AT	BT
P1	0	7
P2	1	4
P3	3	3
P4	4	2

Chart:



Response Ratio: P2 = (6+4)/4 = 2.5

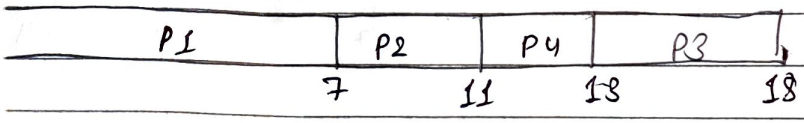
P3 = (4+3)/3 = 2.33

P4 = (3+2)/2 = 2.5

Response Ratio:

P3 = $\frac{8+3}{3}$ = 3.667

P4 = $\frac{7+2}{2}$ = 4.5



Process	AT	BT	FT	TAT	WT
P1	0	7	7	7	0
P2	1	4	11	10	6
P3	3	3	16	13	10
P4	4	2	13	9	7

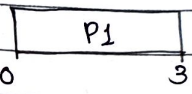
∴ Average Turnaround time = 9.75

Average Waiting time = 5.75 //

(d)

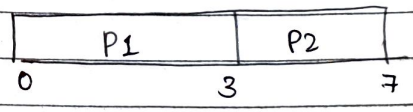
Process	Arrival Time	Burst Time
P1	0	3
P2	2	4
P3	3	5
P4	4	2

Chart:



Response Ratio: P2 = (1+4)/4 = 1.25

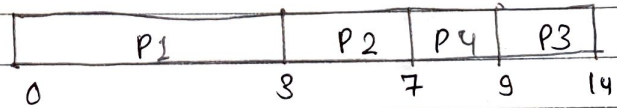
P3 = (0+5)/5 = 1



Response Ratio:

P3 = $\frac{4+5}{5}$ = 1.8

P4 = $\frac{8+2}{2}$ = 2.5



Process	AT	BT	FT	TAT	WT
P1	0	3	3	3	0
P2	2	4	7	5	1
P3	3	5	14	11	6
P4	4	7	9	5	3

∴ Average Turnaround time = $\frac{(3+5+11+5)}{4} = 6$

Average Waiting time = $\frac{0+1+6+3}{4} = 2.5$

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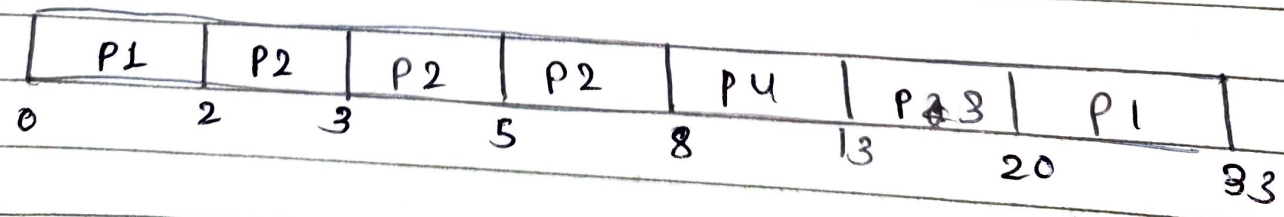
★ Shortest Remaining Time Next:

a)

Process	Arrival Time	Burst Time
P1	0	15
P2	2	6
P3	3	7
P4	5	5

⇒ Gantt Chart:



Process	AT	BT	FT	TAT	WT
P1	0	15	33	33	17
P2	2	6	8	6	0
P3	3	7	20	17	10
P4	5	5	13	8	3

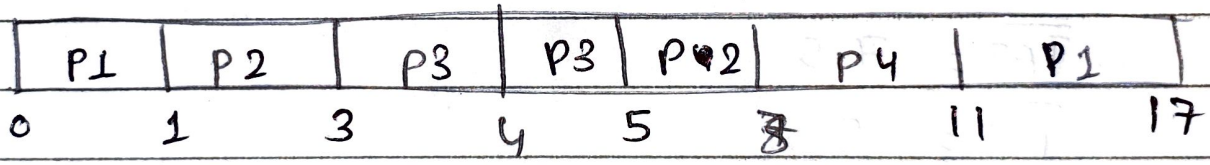
$\therefore \overline{TAT} = 16$

$\overline{WT} = 7.5$ //

(b)

Process	AT	BT
P1	0	7
P2	1	5
P3	3	2
P4	4	3

Gantt Chart:



Process	AT	BT	FT	TAT	WT
P1	0	7	17	17	10
P2	1	5	7	6	1
P3	3	2	5	2	0
P4	4	3	11	7	4

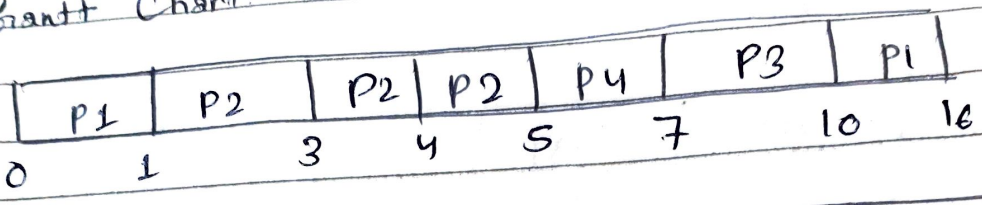
$\therefore \overline{TAT} = 8$

$\overline{WT} = 3.75$ //

c)

Process	AT	BT
P1	0	7
P2	1	4
P3	3	3
P4	4	2

Gantt Chart:



Process	AT	BT	CT	TAT	WT
P1	0	7	16	16	9
P2	1	4	5	4	0
P3	3	3	10	7	4
P4	4	2	7	3	1

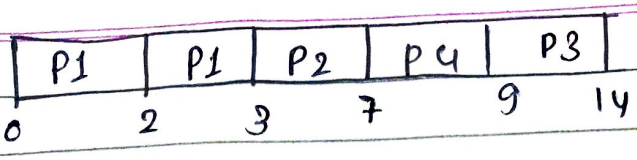
$\therefore \overline{TAT} = 7.5$

$\overline{WT} = 3.5$

d)

Process	AT	BT
P1	0	3
P2	2	4
P3	3	5
P4	4	2

Gantt Chart:



Process	AT	BT	FT	TAT	WT
P1	0	3	3	3	0
P2	2	4	7	5	1
P3	3	5	14	11	6
P4	4	2	9	5	3

$\therefore \overline{TAT} = 6$

$\overline{WT} = 2.5$.