

## Procedure to solve RR questions.

*Example-1:* Consider the following table of arrival time and burst time for four processes P1, P2, P3, and P4 and given Time **Quantum = 2**.

Draw Gantt Chart and calculate average turnaround time according to RR scheduling.

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

**Solution:**

**At time = 0,**

- ❖ At time =0, we find from the above table which processes have entered the system.
- ❖ We see that P1 has arrived in the system. So select it and bring in the Gantt Chart and execute P1.
- ❖ P1 will execute for time quantum time of 2 sec as given in the question. After executing for 2 sec its remaining time will be now 3.

Process	Arrival Time	Burst Time
P1	0	<del>5</del> 3
P2	1	4
P3	2	2
P4	4	1

**Note:** We have to maintain two queues: Ready Queue and Running Queue. Ready queue will contain those processes which are ready for execution and Running queue will contain those process which are currently running in the system.

Ready Queue: Initially at time 0 only P1 is ready and we bring it in the ready queue.

**P1**

From ready queue select the first process P1 and bring it in running queue and execute for 2 sec as follows:

<b>0</b>	<b>2</b>								
P1									

**At time = 2,**

- ❖ At time =2 we find from the above table which processes have entered the system.

- ❖ We see that P2 and P3 have arrived in the system. Bring P1 and P2 in the ready queue and also bring P1 at last position in the queue.
- ❖ So our ready queue looks like as follows:

<del>P1</del>	P2	P3	P1
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- ❖ Now Select P2 from ready queue and bring it in running queue and execute for 2 sec.

<del>P1</del>	<del>P2</del>	P3	P1
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- ❖ The following is the gantt chart:

0	2	4							
P1	P2								

Process	Arrival Time	Burst Time	
P1	0	<del>5</del>	3
P2	1	<del>4</del>	2
P3	2	2	
P4	4	1	

**At time = 4,**

- ❖ At time =4 we find from the above table which processes have entered the system.
- ❖ We see that P4 has arrived in the system. Bring P4 in the ready queue and also bring P2 at last position in the queue.
- ❖ So our ready queue looks like as follows:

<del>P1</del>	<del>P2</del>	P3	P1	P4	P2
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- ❖ Now Select P3 from ready queue and bring it in running queue and execute for 2 sec.

<del>P1</del>	<del>P2</del>	<del>P3</del>	P1	P4	P2
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- ❖ The following is the gantt chart:

0	2	4	6						
P1	P2	P3							

Process	Arrival Time	Burst Time
P1	0	<del>5</del>
P2	1	<del>4</del>
P3	2	<del>2</del>
P4	4	1

3  
2  
0

At time = 6,

- ❖ At time =6 we find from the above table which processes have entered the system.
- ❖ We see that all processes have arrived in the system. That means we have covered all the programs. Now select the next process from the ready queue that is P1 and bring it in the running queue.
- ❖ So our ready queue looks like as follows:

<del>P1</del>	<del>P2</del>	<del>P3</del>	<del>P1</del>	P4	P2
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- ❖ The following is the gantt chart:

0	2	4	6	8					
P1	P2	P3	P1						

Process	Arrival Time	Burst Time
P1	0	<del>5</del>
P2	1	<del>4</del>
P3	2	<del>2</del>
P4	4	1

~~3~~ 1  
2  
0

- ❖ Now P1 still requires 1 sec to complete but its chance has gone now. So we preempt the process P1 and put in the last of ready queue as follows:

<del>P1</del>	<del>P2</del>	<del>P3</del>	<del>P1</del>	P4	P2	P1
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- ❖ Now select the next process in the ready queue and bring it in the running queue and execute it for 2 sec. (here it is now P4). Since P4 require only 1 sec to complete so it will run only for 1 sec.

<del>P1</del>	<del>P2</del>	<del>P3</del>	<del>P1</del>	<del>P4</del>	P2	P1
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❖ The following is the gantt chart:

0	2	4	6	8	9				
P1	P2	P3	P1	P4					

Process	Arrival Time	Burst Time		
P1	0	<del>5</del>	<del>3</del>	1
P2	1	<del>4</del>	2	
P3	2	<del>2</del>	0	
P4	4	<del>1</del>	0	

❖ Now select the next process that is P2 from the Ready queue and bring it in the gantt chart and execute it for 2 sec as follows:

<del>P1</del>	<del>P2</del>	<del>P3</del>	<del>P1</del>	<del>P4</del>	<del>P2</del>	P1
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❖ The following is the gantt chart:

0	2	4	6	8	9	11			
P1	P2	P3	P1	P4	P2				

Process	Arrival Time	Burst Time		
P1	0	<del>5</del>	<del>3</del>	1
P2	1	<del>4</del>	<del>2</del>	0
P3	2	<del>2</del>	0	
P4	4	<del>1</del>	0	

❖ Now only one process that is P1 is remaining and it requires only 1 sec to complete. So the final gantt chart is:

0	2	4	6	8	9	11	12		
P1	P2	P3	P1	P4	P2	P1			

**Calculating Turnaround Time:**

$$T.T = \text{Completion Time} - \text{Arrival Time}$$

$$T_{P1} = 12 - 0 = 12$$

$$T_{P2} = 11 - 1 = 10$$

$$T_{P3} = 6 - 2 = 4$$

$$T_{P4} = 9 - 4 = 5$$

**Calculating Waiting Time:**

$$W.T = T.T - \text{Burst Time}$$

$$W_{P1} = 12 - 5 = 7$$

$$W_{P2} = 10 - 4 = 6$$

$$W_{P3} = 4 - 2 = 2$$

$$W_{P4} = 5 - 1 = 4$$

$$\text{Average Waiting Time} = (7 + 6 + 2 + 4) / 4 = 4.7$$