# Practical 2

Execute various UNIX system calls for
i. Process management
ii. File management
iii. Input/output Systems calls

## System Calls -

The interface between a process and an operating system is provided by system calls.They are usually made when a process in user mode requires access to a resource. Then it requests the kernel to provide the resource via a system call.
Types of system calls -

1. Process management
2. File management
3. Input/output calls
4. Device management
5. Communication

There are around 80 system calls in the Unix interface currently. Details about some of the important ones are given as follows -

| System Call | Description |
|---|---|
| exec() | This system call runs when an executable file in the context of an already running process that replaces the older executable file. |
| wait() | This suspends the parent process and executes child process |
| access() | This checks if a calling process has access to the required file |
| chdir() | The chdir command changes the current directory of the system |

| | |
|---|---|
| chmod() | The mode of a file can be changed using this command |
| chown() | This changes the ownership of a particular file |
| kill() | This system call sends kill signal to one or more processes |
| link() | A new file name is linked to an existing file using link system call. |
| open() | This opens a file for the reading or writing process |
| pause() | The pause call suspends a file until a particular signal occurs. |
| stime() | This system call sets the correct time. |
| times() | Gets the parent and child process times |
| alarm() | The alarm system call sets the alarm clock of a process |
| fork() | A new process is created using this command |
| chroot() | This changes the root directory of a file. |
| exit() | The exit system call is used to exit a process. |

# Practical 3

## Code-

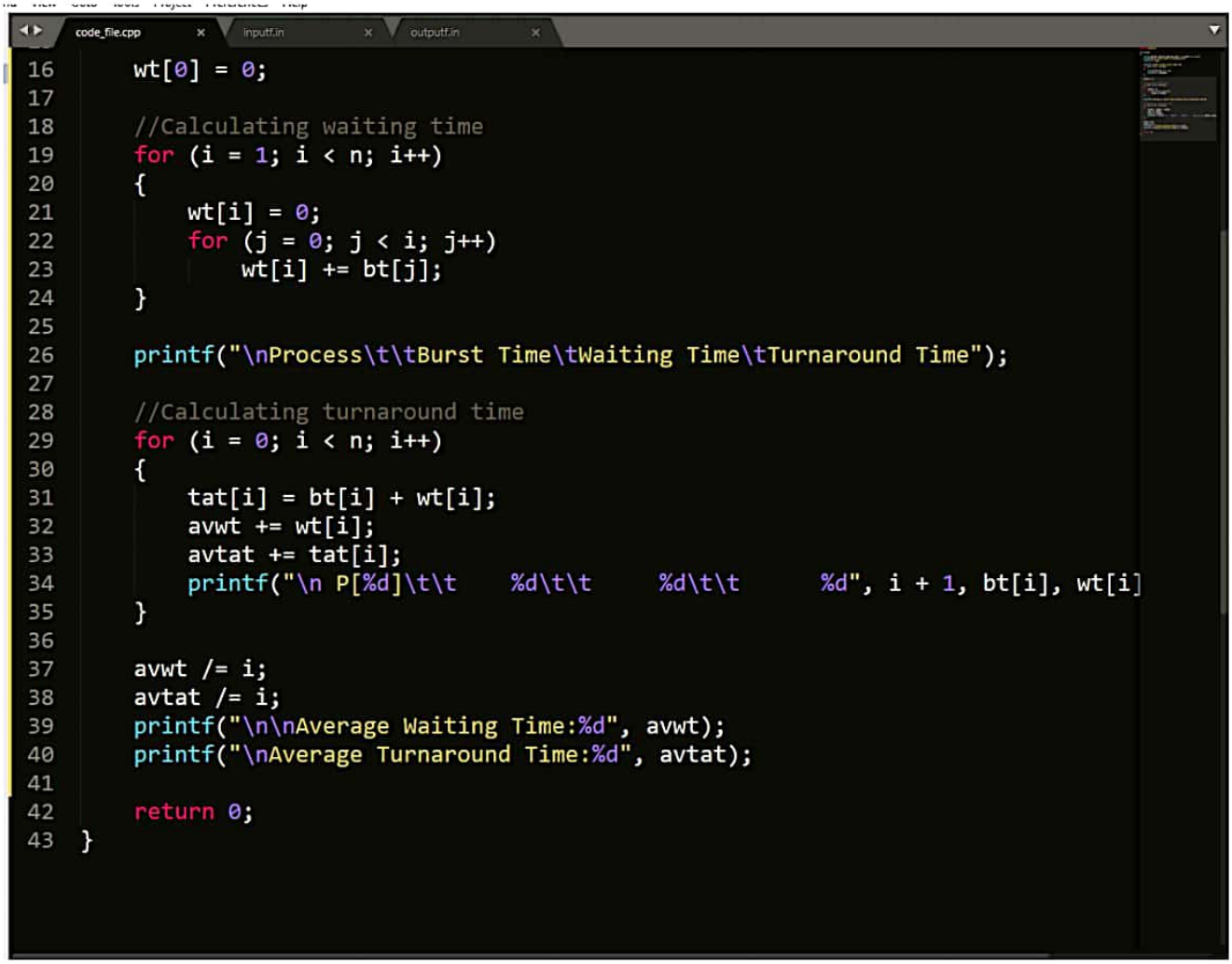
```
#include<stdio.h>

int main()
{
	int n, bt[20], wt[20], tat[20], avwt = 0, avtat = 0, i, j;
	printf("Enter total number of processes:");
	scanf("%d", &n);

	printf("\nEnter Process Burst Time\n");
	for (i = 0; i < n; i++)
	{
		printf("P[%d]:", i + 1);
		scanf("%d", &bt[i]);
	}

	wt[0] = 0;

	//Calculating waiting time
	for (i = 1; i < n; i++)
	{
		wt[i] = 0;
		for (j = 0; j < i; j++)
			wt[i] += bt[j];
	}

	printf("\nProcess\t\tBurst Time\tWaiting Time\tTurnaround Time");

	//Calculating turnaround time
	for (i = 0; i < n; i++)
	{
		tat[i] = bt[i] + wt[i];
		avwt += wt[i];
		avtat += tat[i];
		printf("\n P[%d]\t\t    %d\t\t     %d\t\t      %d", i + 1, bt[i], wt[i], tat[i]);
	}
```

```
        avwt /= i;
        avtat /= i;
        printf("\n\nAverage Waiting Time:%d", avwt);
        printf("\nAverage Turnaround Time:%d", avtat);

        return 0;
}
```

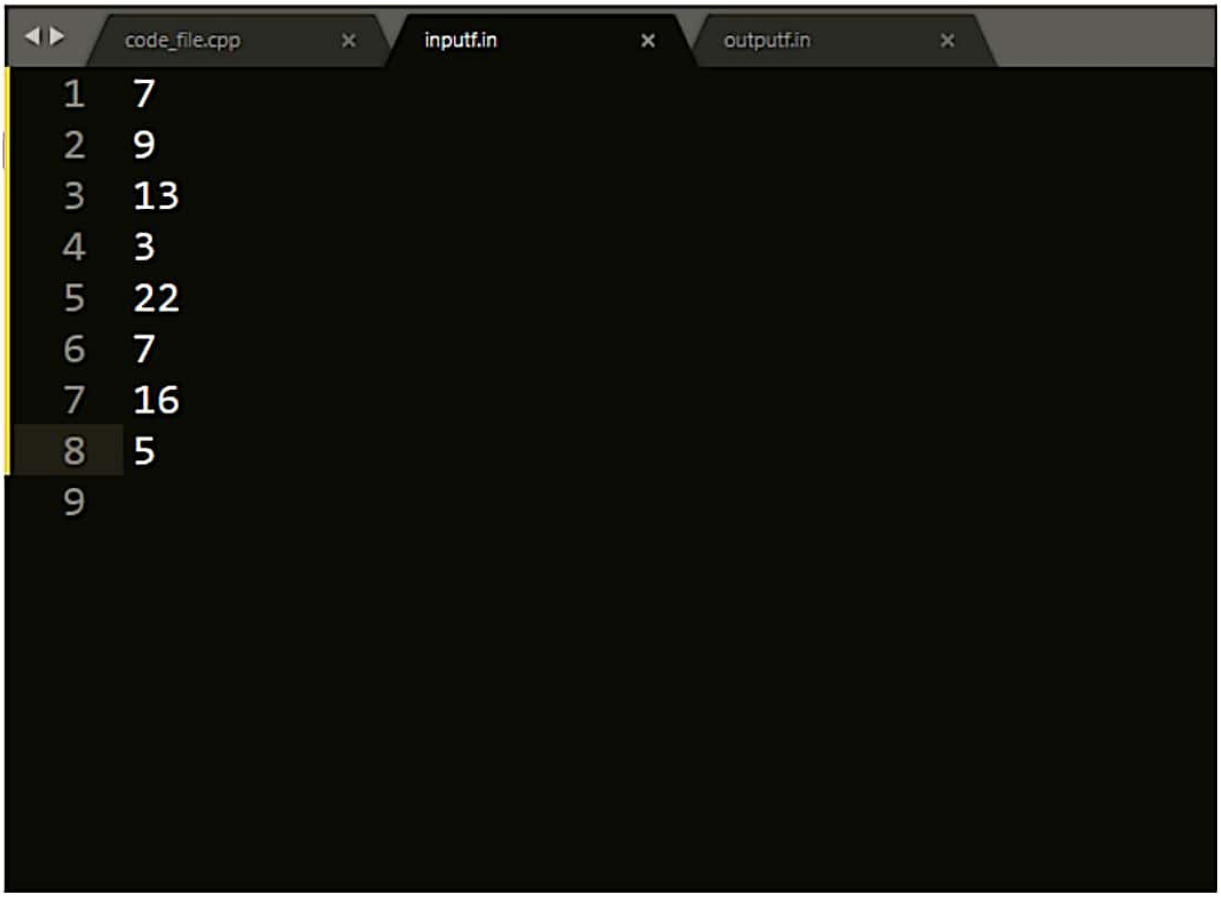
# Screenshots-

code_file.cpp | inputf.in | outputf.in

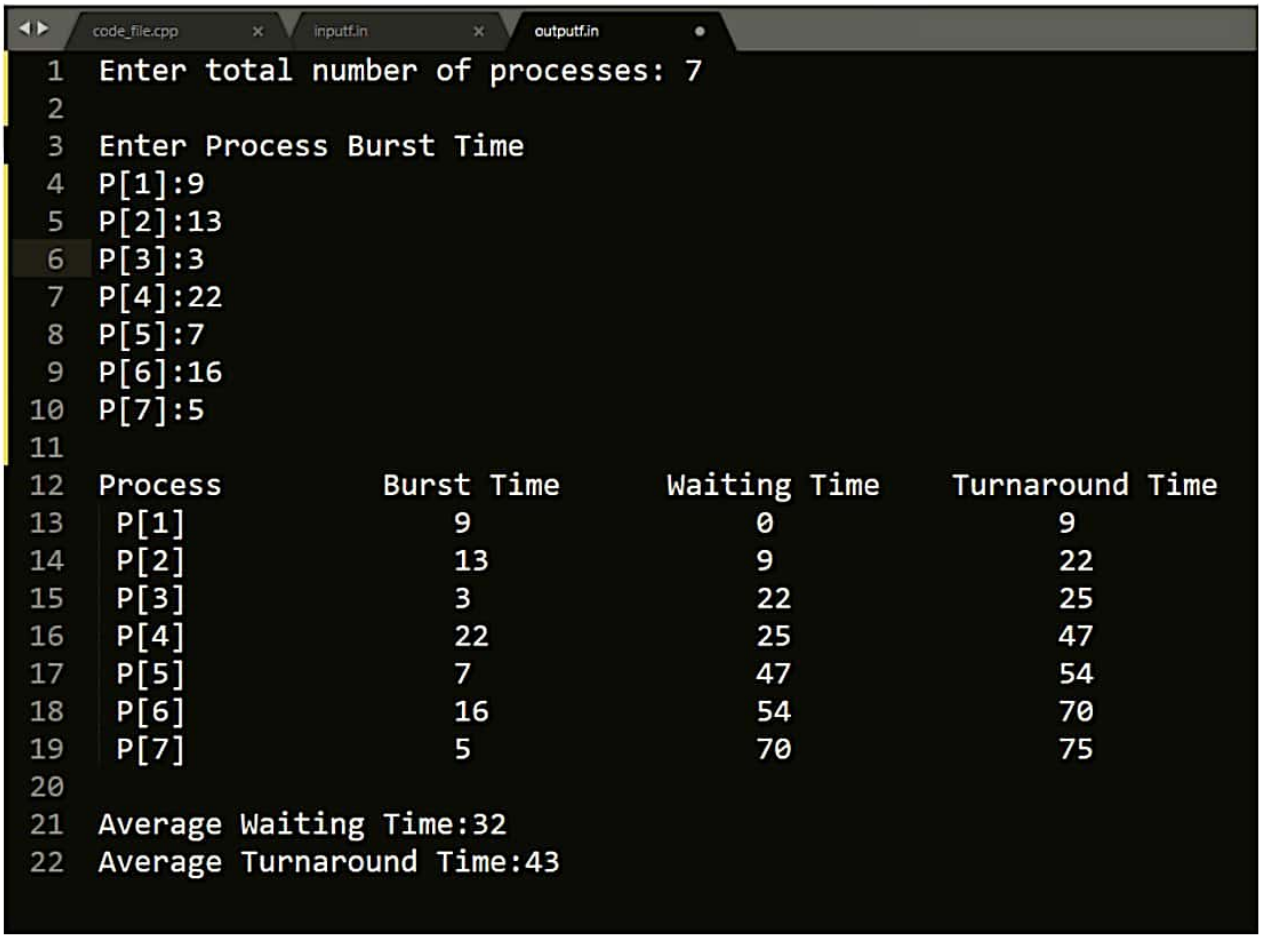
```c
#include<stdio.h>

int main()
{
    int n, bt[20], wt[20], tat[20], avwt = 0, avtat = 0, i, j;
    printf("Enter total number of processes:");
    scanf("%d", &n);

    printf("\nEnter Process Burst Time\n");
    for (i = 0; i < n; i++)
    {
        printf("P[%d]:", i + 1);
        scanf("%d", &bt[i]);
    }

    wt[0] = 0;

    //Calculating waiting time
    for (i = 1; i < n; i++)
    {
        wt[i] = 0;
        for (j = 0; j < i; j++)
            wt[i] += bt[j];
    }

    printf("\nProcess\t\tBurst Time\tWaiting Time\tTurnaround Time");

```



# Input-



# Output-



# Practical 4

## Code-

```
#include<stdio.h>

int main() {

	int bt[20], p[20], wt[20], tat[20], i, j, n, total = 0, pos, temp;
	float avg_wt, avg_tat;
	printf("Enter number of process:");
	scanf("%d", &n);

	printf("\nEnter Burst Time:\n");
	for (i = 0; i < n; i++) {
		printf("\np%d:", i + 1);
		scanf("%d", &bt[i]);
		p[i] = i + 1;		//contains process number
	}

	//sorting burst time in ascending order using selection sort
	for (i = 0; i < n; i++) {
		pos = i;
		for (j = i + 1; j < n; j++) {
			if (bt[j] < bt[pos])
				pos = j;
		}

		temp = bt[i];
		bt[i] = bt[pos];
		bt[pos] = temp;

		temp = p[i];
		p[i] = p[pos];
		p[pos] = temp;
	}

	wt[0] = 0;

	for (i = 1; i < n; i++)
	{
```

```
            wt[i] = 0;
            for (j = 0; j < i; j++)
                  wt[i] += bt[j];

            total += wt[i];
      }

      avg_wt = (float)total / n;  //average waiting time
      total = 0;

      printf("\nProcess\t    Burst Time    \tWaiting Time\tTurnaround Time");
      for (i = 0; i < n; i++)
      {
            tat[i] = bt[i] + wt[i]; //calculate turnaround time
            total += tat[i];
            printf("\n p%d\t\t       %d\t\t       %d\t\t\t    %d",
                  p[i], bt[i], wt[i], tat[i]);
      }

      avg_tat = (float)total / n; //average turnaround time
      printf("\n\nAverage Waiting Time=%f", avg_wt);
      printf("\nAverage Turnaround Time=%f\n", avg_tat);
}
```

# Screenshots-

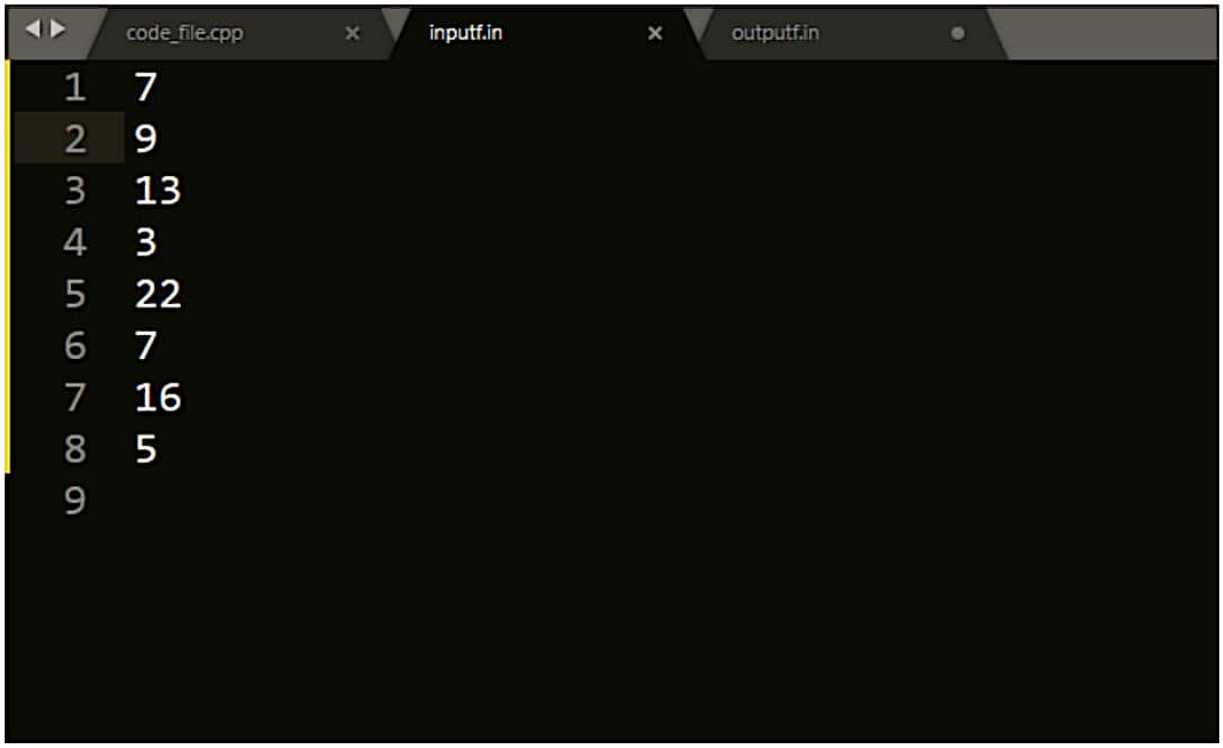
code_file.cpp • inputf.in × outputf.in •

```c
#include<stdio.h>

int main(){

    int bt[20], p[20], wt[20], tat[20], i, j, n, total = 0, pos, temp;
    float avg_wt, avg_tat;
    printf("Enter number of process:");
    scanf("%d", &n);

    printf("\nEnter Burst Time:\n");
    for (i = 0; i < n; i++){
        printf("\np%d:", i + 1);
        scanf("%d", &bt[i]);
        p[i] = i + 1;       //contains process number
    }

    //sorting burst time in ascending order using selection sort
    for (i = 0; i < n; i++){
        pos = i;
        for (j = i + 1; j < n; j++){
            if (bt[j] < bt[pos])
                pos = j;
        }

        temp = bt[i];
        bt[i] = bt[pos];
        bt[pos] = temp;

        temp = p[i];
        p[i] = p[pos];
        p[pos] = temp;
    }
```

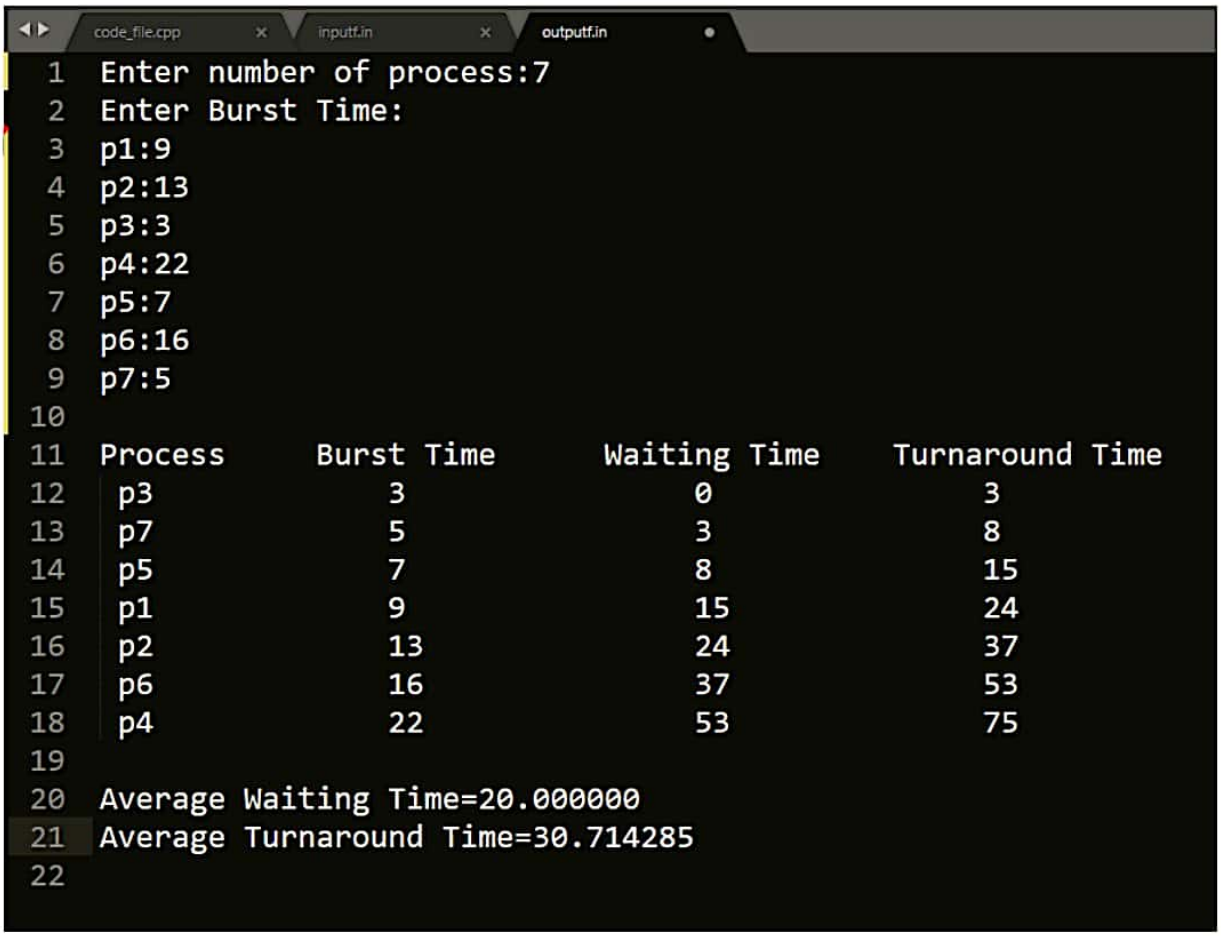
code_file.cpp • inputf.in × outputf.in •

```
31          p[pos] = temp;
32      }
33
34      wt[0] = 0;
35
36      for (i = 1; i < n; i++)
37      {
38          wt[i] = 0;
39          for (j = 0; j < i; j++)
40              wt[i] += bt[j];
41
42          total += wt[i];
43      }
44
45      avg_wt = (float)total / n;  //average waiting time
46      total = 0;
47
48      printf("\nProcess\t    Burst Time    \tWaiting Time\tTurnaround Time");
49      for (i = 0; i < n; i++)
50      {
51          tat[i] = bt[i] + wt[i]; //calculate turnaround time
52          total += tat[i];
53          printf("\n p%d\t\t        %d\t\t         %d\t\t\t     %d",
54                  p[i], bt[i], wt[i], tat[i]);
55      }
56
57      avg_tat = (float)total / n; //average turnaround time
58      printf("\n\nAverage Waiting Time=%f", avg_wt);
59      printf("\nAverage Turnaround Time=%f\n", avg_tat);
60  }
```

# Input-



# Output-



# Practical 5
## Shortest Remaining Time First (Preemptive)

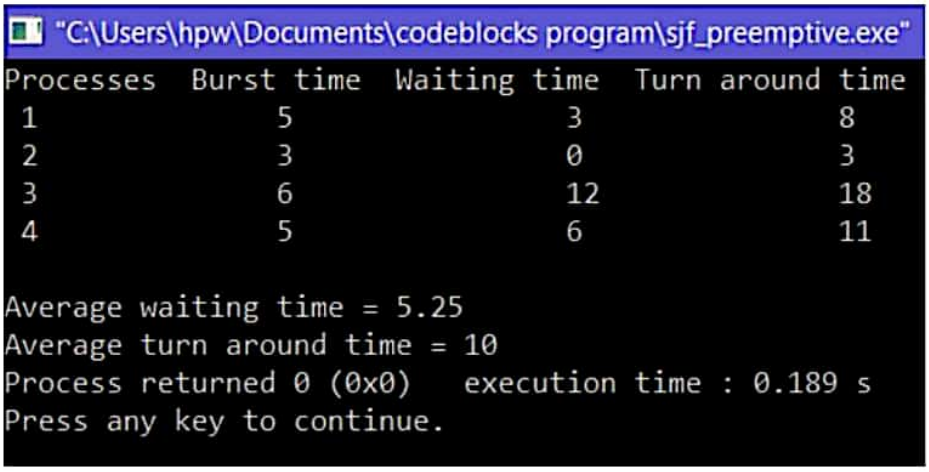
Code →

```
#include <bits/stdc++.h>
using namespace std;
//structure for every process
struct Process {
  int pid; // Process ID
  int bt; // Burst Time
  int art; // Arrival Time
};
void findTurnAroundTime(Process proc[], int n, int wt[], int tat[]) {
  for (int i = 0; i < n; i++)
  tat[i] = proc[i].bt + wt[i];
}
//waiting time of all process
void findWaitingTime(Process proc[], int n, int wt[]) {
  int rt[n];
  for (int i = 0; i < n; i++)
  rt[i] = proc[i].bt;
  int complete = 0, t = 0, minm = INT_MAX;
  int shortest = 0, finish_time;
  bool check = false;
  while (complete != n) {
    for (int j = 0; j < n; j++) {
      if ((proc[j].art <= t) && (rt[j] < minm) && rt[j] > 0) {
        minm = rt[j];
        shortest = j;
```

```
        check = true;
      }
    }
    if (check == false) {
      t++;
      continue;
    }
    // decrementing the remaining time
    rt[shortest]--;
    minm = rt[shortest];
    if (minm == 0)
      minm = INT_MAX;
      // If a process gets completely
      // executed
      if (rt[shortest] == 0) {
        complete ++;
        check = false;
        finish_time = t + 1;
        // Calculate waiting time
        wt[shortest] = finish_time -
        proc[shortest].bt -
        proc[shortest].art;
        if (wt[shortest] < 0)
          wt[shortest] = 0;
      }
      // Increment time
      t++;
  }
}
// Function to calculate average time
void findavgTime(Process proc[], int n) {
  int wt[n], tat[n], total_wt = 0,
```

```
  total_tat = 0;
  // Function to find waiting time of all
  // processes
  findWaitingTime(proc, n, wt);
  // Function to find turn around time for
  // all processes
  findTurnAroundTime(proc, n, wt, tat);
  cout << "Processes " << " Burst time " << " Waiting time " << "
Turnaround time\n";
  for (int i = 0; i < n; i++) {
    total_wt = total_wt + wt[i];
    total_tat = total_tat + tat[i];
    cout << " " << proc[i].pid << "\t\t" << proc[i].bt << "\t\t " << wt[i] << "\t\t "
<< tat[i] << endl;
  }
  cout << "\nAverage waiting time = " << (float)total_wt / (float)n; cout <<
"\nAverage turnaround time = " << (float)total_tat / (float)n;
}
// main function
int main() {
  Process proc[] = { { 1, 5, 1 }, { 2, 3, 1 }, { 3, 6, 2 }, { 4, 5, 3 } };
  int n = sizeof(proc) / sizeof(proc[0]);
  findavgTime(proc, n);
  return 0;
}
```

## Output →



# Practical 6
# Priority Scheduling (Non-Preemptive)

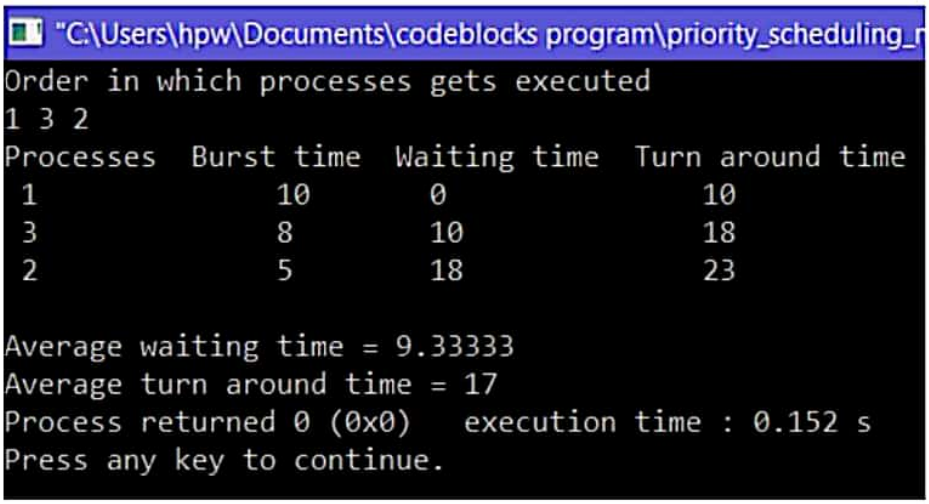
**Code →**

```
#include<bits/stdc++.h>
using namespace std;
struct Process {
   int pid; // Process ID
   int bt; // CPU Burst time required
   int priority; // Priority of this process
};
// sorting the Process acc. to the priority
bool compare(Process a, Process b) {
   return (a.priority > b.priority);
}
void waitingtime(Process pro[], int n, int wt[]) {
   // Initial waiting time for a process is 0
   wt[0] = 0;
   // calculating waiting time
   for (int i = 1; i < n ; i++ )
      wt[i] = pro[i-1].bt + wt[i-1] ;
}
 // Function to calculate turn around time
void turnaround( Process pro[], int n, int wt[], int tat[]) {
   // calculating turnaround time by adding
   // bt[i] + wt[i]
   for (int i = 0; i < n ; i++)
      tat[i] = pro[i].bt + wt[i];
```

```
}
//Function to calculate average time
void avgtime(Process pro[], int n) {
   int wt[n], tat[n], total_wt = 0, total_tat = 0;
   //Function to find waiting time of all processes
   waitingtime(pro, n, wt);
   //Function to find turn around time for all processes
   turnaround(pro, n, wt, tat);
   //Display processes along with all details
   cout << "\nProcesses "<< " Burst time " << " Waiting time " << "
Turn around time\n";
   // Calculate total waiting time and total turn
   // around time
   for (int i=0; i<n; i++) {
      total_wt = total_wt + wt[i];
      total_tat = total_tat + tat[i];
      cout << " " << pro[i].pid << "\t\t" << pro[i].bt << "\t " << wt[i] <<
"\t\t " << tat[i] <<endl;
   }
   cout << "\nAverage waiting time = " << (float)total_wt / (float)n;
   cout << "\nAverage turnaround time = " << (float)total_tat /
(float)n;
}
void scheduling(Process pro[], int n) {
   // Sort processes by priority
   sort(pro, pro + n, compare);
   cout<< "Order in which processes gets executed \n";
   for (int i = 0 ; i < n; i++)
      cout << pro[i].pid <<" " ;
   avg time(pro, n);
```

```
}
// main function
int main() {
   Process pro[] = {{1, 10, 2}, {2, 5, 0}, {3, 8, 1}};
   int n = sizeof pro / sizeof pro[0];
   scheduling(pro, n);
   return 0;
}
```

**Output →**



# Practical 7

## Round Robin Scheduling

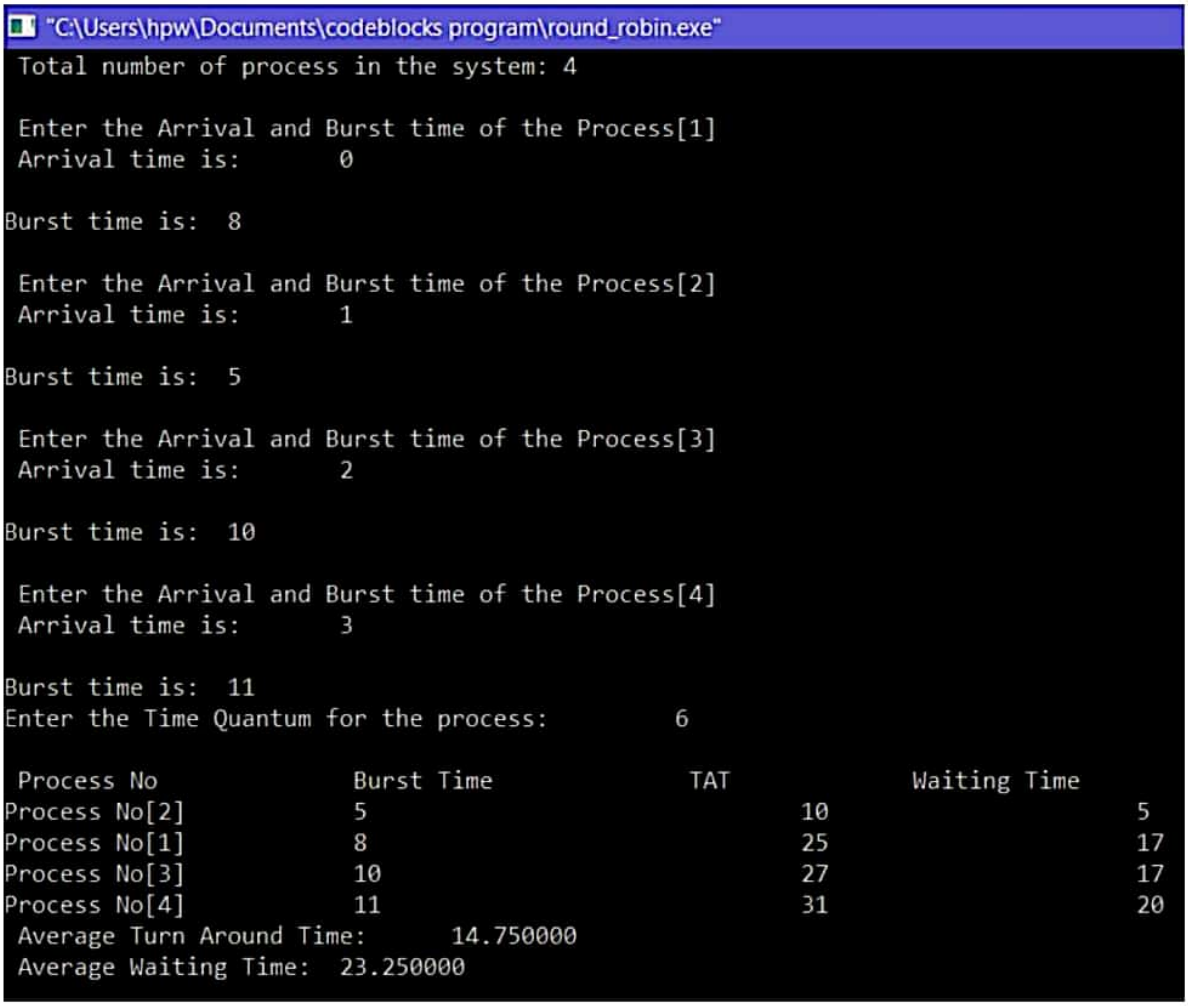
Code →

```
#include<stdio.h>
#include<conio.h>

void main()
{
   // initialize the variable name
   int i, NOP, sum=0,count=0, y, quant, wt=0, tat=0, at[10], bt[10], temp[10];
   float avg_wt, avg_tat;
   printf(" Total number of process in the system: ");
   scanf("%d", &NOP);
   y = NOP; // Assign the number of process to variable y

// Use for loop to enter the details of the process like Arrival time and the
Burst Time
for(i=0; i<NOP; i++)
{
printf("\n Enter the Arrival and Burst time of the Process[%d]\n", i+1);
printf(" Arrival time is: \t");  // Accept arrival time
scanf("%d", &at[i]);
printf(" \nBurst time is: \t"); // Accept the Burst time
scanf("%d", &bt[i]);
temp[i] = bt[i]; // store the burst time in temp array
}
// Accept the Time qunat
printf("Enter the Time Quantum for the process: \t");
scanf("%d", &quant);
```

```
// Display the process No, burst time, Turn Around Time and the waiting
time
printf("\n Process No \t\t Burst Time \t\t TAT \t\t Waiting Time ");
for(sum=0, i = 0; y!=0; )
{
if(temp[i] <= quant && temp[i] > 0) // define the conditions
{
   sum = sum + temp[i];
   temp[i] = 0;
   count=1;
   }
   else if(temp[i] > 0)
   {
      temp[i] = temp[i] - quant;
      sum = sum + quant;
   }
   if(temp[i]==0 && count==1)
   {
      y--; //decrement the process no.
      printf("\nProcess No[%d] \t\t %d\t\t\t\t %d\t\t\t %d", i+1, bt[i],
sum-at[i], sum-at[i]-bt[i]);
      wt = wt+sum-at[i]-bt[i];
      tat = tat+sum-at[i];
      count =0;
   }
   if(i==NOP-1)
   {
      i=0;
   }
   else if(at[i+1]<=sum)
```

```
    {
        i++;
    }
    else
    {
        i=0;
    }
}
// represents the average waiting time and Turn Around time
avg_wt = wt * 1.0/NOP;
avg_tat = tat * 1.0/NOP;
printf("\n Average Turnaround Time: \t%f", avg_wt);
printf("\n Average Waiting Time: \t%f", avg_tat);
getch();
}
```

Output⟶



# Banker's Algorithm

## Code →

```
// Banker's Algorithm
#include <iostream>
using namespace std;

int main()
{
	// P0, P1, P2, P3, P4 are the Process names here

	int n, m, i, j, k;
	n = 5; // Number of processes
	m = 3; // Number of resources
	int alloc[5][3] = { { 0, 1, 0 }, // P0 // Allocation Matrix
	                    { 2, 0, 0 }, // P1
	                    { 3, 0, 2 }, // P2
	                    { 2, 1, 1 }, // P3
	                    { 0, 0, 2 } }; // P4

	int max[5][3] = { { 7, 5, 3 }, // P0 // MAX Matrix
	                  { 3, 2, 2 }, // P1
	                  { 9, 0, 2 }, // P2
	                  { 2, 2, 2 }, // P3
	                  { 4, 3, 3 } }; // P4

	int avail[3] = { 3, 3, 2 }; // Available Resources

	int f[n], ans[n], ind = 0;
	for (k = 0; k < n; k++) {
		f[k] = 0;
	}
	int need[n][m];
	for (i = 0; i < n; i++) {
```

```
            for (j = 0; j < m; j++)
                need[i][j] = max[i][j] - alloc[i][j];
    }
    int y = 0;
    for (k = 0; k < 5; k++) {
            for (i = 0; i < n; i++) {
                if (f[i] == 0) {

                    int flag = 0;
                    for (j = 0; j < m; j++) {
                        if (need[i][j] > avail[j]){
                            flag = 1;
                            break;
                        }
                    }

                    if (flag == 0) {
                        ans[ind++] = i;
                        for (y = 0; y < m; y++)
                            avail[y] += alloc[i][y];
                        f[i] = 1;
                    }
                }
            }
    }

    cout << "Following is the SAFE Sequence" << endl;
    for (i = 0; i < n - 1; i++)
            cout << " P" << ans[i] << " ->";
    cout << " P" << ans[n - 1] <<endl;

    return (0);
}
```

## Output →