Tutorial-5

1. Three processes A, B and C each execute a loop of 100 iterations. In each iteration of the loop, a process performs a single computation that requires tc CPU milliseconds and then initiates a single I/O operation that lasts for tio milliseconds. It is assumed that the computer where the processes execute has enough I/O devices and the OS of the computer assigns different I/O devices to each process. Also, the scheduling overhead of the OS is negligible. The processes have the following characteristics:

PID	tc	tio
A	100 ms	500 ms
B	350 ms	500 ms
C	200 ms	500 ms

The processes A, B, and C are started at times 0, 5 and 10 milliseconds respectively, in a pure time-sharing system (round robin scheduling) that uses a time slice of 50 milliseconds. The time in milliseconds at which process C would complete its first I/O operation is _____.

a. 500
b. 1000
c. 2000
d. 10000

2. Consider the set of 5 processes whose arrival time and burst time are given below-

PID	Arrival time	Burst time
P1	0	5
P2	1	3
P3	2	1
P4	3	2
P5	4	3

If the CPU scheduling policy is Round Robin with time quantum = 2 unit, calculate the average waiting time and average turn-around time.

3. Consider the 3 processes, P1, P2 and P3 with its arrival time and burst time shown in the table

PID	Arrival Time	Burst Time
P1	0	5
P2	1	7
P3	3	4

The completion order of the 3 processes under the policies FCFS and RR2 (round robin scheduling with CPU quantum of 2-time units) are _____.

4. A uni-processor computer system only has two processes, both of which alternate 10ms CPU bursts with 90ms I/O bursts. Both the processes were created at nearly the same time. The I/O of both processes can proceed in parallel. Which of the following scheduling strategies will result in the least CPU utilization (over a long period of time) for this system?
   a. First come first served scheduling

b. Shortest remaining time first scheduling
c. Static priority scheduling with different priorities for the two processes
d. Round robin scheduling with a time quantum of 5 ms

5. A system uses the following preemptive priority scheduling algorithm (process with larger priority numbers have higher priority). Processes enter the system with a priority of 1. While waiting on the ready queue, a process's priority changes at rate α. While running, a process's priority changes at the rate β.
   a) What is the algorithm that results from $\beta > \alpha > 1$?
   b) What is the algorithm that results from $\alpha < \beta < 1$?

6. On a system using round-robin scheduling, let s represent the time needed to perform a process switch, q represent the round- robin time quantum, and r represent the average time a process runs before blocking on I/O. Give a formula for CPU efficiency given the following.
   a) $q = \infty$
   b) $q = r$
   c) $s < q < r$
   d) $s = q < r$