

Class: _____

ID: _____

Name: _____

1. What are two differences between user-level threads and kernel-level threads? Under what circumstances is one type better than the other?

☞ (1) Two differences:

- (a) User-level threads are unknown by the kernel, whereas the kernel is aware of kernel threads.
- (b) User-level threads are scheduled by the thread library and the kernel schedules kernel-level threads.

(2) Kernel-level threads are better than user-level threads when

- (a) The thread performs a blocking system call
- (b) In a multiprocessor environment

(3) User-level threads are generally fast to create and manage; they are better than kernel-level threads when no blocking system call is performed.

2. Can a multithreaded solution using multiple user-level threads achieve better performance on a multiprocessor system than on a single-processor system? (4%)

☞ A multithreaded system comprising of multiple user-level threads cannot make use of the different processors in a multiprocessor system simultaneously. The operating system sees only a single process and will not schedule the different threads of the process on separate processors. Consequently, there is no performance benefit associated with executing multiple user-level threads on a multiprocessor system.

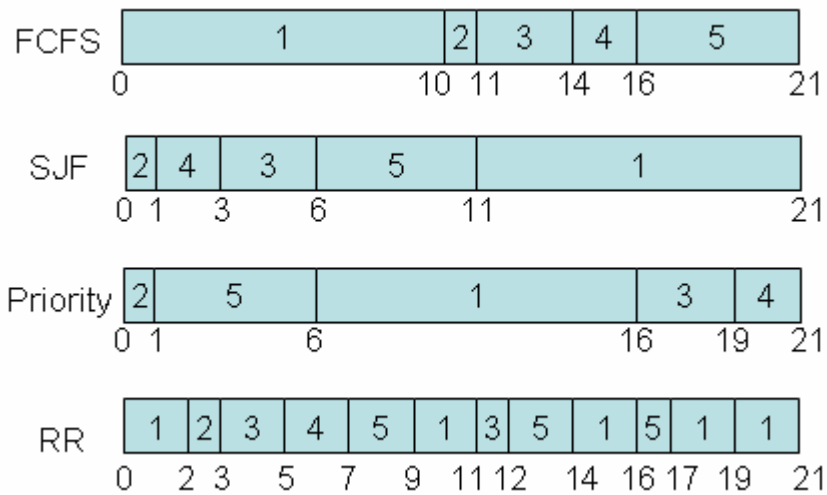
3. Consider the following set of processes, with the length of the CPU-burst time given in milliseconds:

<u>Process</u>	<u>Burst Time</u>	<u>Priority</u>
P ₁	10	3
P ₂	1	1
P ₃	3	3
P ₄	2	4
P ₅	5	2

The processes are assumed to have arrived in the order P₁, P₂, P₃, P₄, P₅, all at time 0.

- (a) Draw four Gantt charts illustrating the execution of these processes using FCFS, SJF, a nonpreemptive priority (a smaller priority number implies a higher priority), and RR (quantum=2) scheduling. (2%)
- (b) What is the turnaround time of each process for each of the scheduling algorithms in part a? (2%)
- (c) What is the waiting time of each process for each of scheduling algorithms in part a? (2%)

(a) The four Gantt charts are



(b) Turnaround time

	FCFS	SJF	Priority	RR
P₁	10	21	16	21
P₂	11	1	1	3
P₃	14	6	19	12
P₄	16	3	21	7
P₅	21	11	6	17

(c) Waiting time

	FCFS	SJF	Priority	RR
P₁	0	11	6	11
P₂	10	0	0	2
P₃	11	3	16	9
P₄	14	1	19	5
P₅	16	6	1	12