

## CoEn 177 Sample Mid-Term Examination

If you are unsure of the meaning of a question, feel free to ask the instructor for clarification. On a similar note, it is important to explicitly state any assumptions you make.

Name:	E-Mail:	@scu.edu
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**Question 1 (4 points):** Briefly describe the main features of each of the following OS architectures:

- a) Virtual Machine
- b) Micro-Kernel

**Question 2 (2 points):** What is the difference between a general-purpose and a real-time operating system?

**Question 3 (2 points):** What is the single most important criteria for an interactive scheduler system to minimize?

**Question 4 (6 points):** For the following list of jobs, (job id, admission time, required CPU time), assume a shortest-job-first schedule is used to determine the ordering of all **none-running** jobs. Each jobs is run to completion before a new job is started, and context switches incur no overhead (i.e., take zero time). The jobs are:

(A, 0, 16), (B, 0, 6), (C, 2, 14), (D, 3, 8), (E, 4, 4), (F, 6, 1)

For this scenario please describe:

- a) The order of execution.
- b) The job completion rate.
- c) The **average** time spent waiting for the CPU.

**Question 5 (5 points):** Implement a binary semaphore using an atomic test-and-clear instruction (TCL). Give the pseudocode for both P(s) and V(s).

**Question 6 (5 points):** Write a function “`swap(int a, int b)`” that exchanges the values of these two variables. Make sure this function is thread-safe (*i.e.* make sure no race conditions can occur).

**Question 7 (7 points):** A system provided a “`burn(image, CD)`” command to send an image file (`image`) to one of six CD-burners (`CD1` or `CD2` or ... `CD6`). The system also provides a “`readCD(CD, image)`” function to create an image file from a CD, *i.e.*, read from a CD to an image file. The system has exactly six CD burners, and no other CD read/write devices. Using any clear pseudocode, show how you would:

- a) Write a “`safe_CD_copy(source, destination)`” that is thread-safe (*i.e.*, can be called by code in an undetermined number of threads without problem). In this case, make sure you avoid deadlocks. (5 points)
- b) Which of the four conditions of deadlock have you addressed ... or, in other words, explain you know your solution will not result in any deadlocks? (2 points)



**Question 8 (8 points):** A system has 50MB of RAM. If we have 5 active processes, and 64-bit addresses, and 8-byte page table entries (PTEs), how much space is used by page tables in this system.

- a) using 8KB pages
- b) using 1KB pages
- c) an inverted page table (again, simply assume 8-byte PTEs, and 8KB pages)

**Question 9 (4 points):** Is the following resource allocation safe?

Free=2	Has	Max
A	2	9
B	1	7
C	4	6
D	2	12
E	6	16

**Question 10 (5 points):** Is the following resource allocation safe? **Can** a deadlock occur from this configuration?

Free=3	Has	Max
A	2	9
B	1	7
C	4	6
D	2	12
E	6	15

Question	Possible	Grade
1	6	
2	2	
3	2	
4	6	
5	5	
6	5	
7	7	
9	8	
9	4	
10	5	
	50	