



**SAMPLE MIDTERM
EXAMINATION**

DURATION: 1.5 HOURS

No. Of Students: 30

Department Name & Course Number: Systems and Computer Engineering SYSC 4001

Course Instructor: Thomas Kunz

AUTHORIZED MEMORANDA:

William Stallings, *Operating Systems: Internals and Design Principles*, 8th edition, Pearson 2015, ISBN-13: 9780133805918 (as physical book, no ebook) or earlier versions of that same book

Students MUST count the number of pages in this examination question paper before beginning to write, and report any discrepancy to a proctor. This question paper has 5 pages + cover page = 6 pages in all.

This examination question paper MAY NOT be taken from the examination room.

**In addition to this question paper, students require: an examination booklet: NO
Scantron Sheet: NO**

Name: _____

Student Number: _____

Question 1: _____ /10

Question 2: _____ /10

Question 3: _____ /10

Question 4: _____ /10

Total: _____ /40

Question 1: Process Description and Control (10 marks)

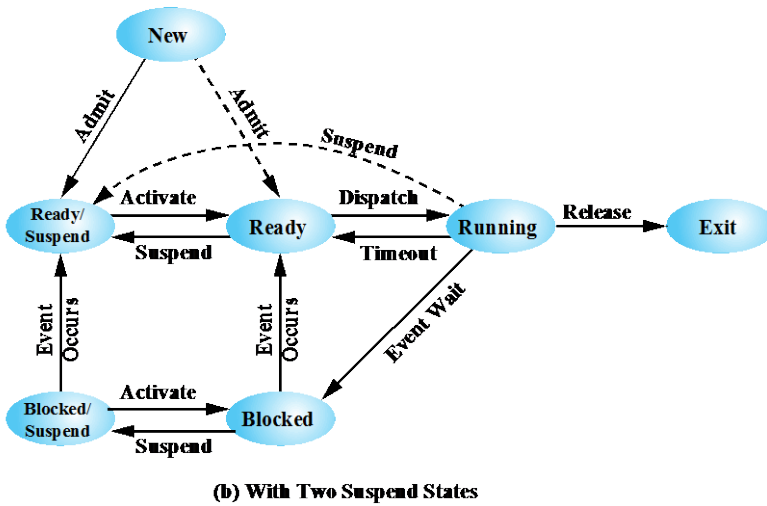


Figure 3.9 Process State Transition Diagram with Suspend States

The above figure, reproduced from the textbook, shows a process state diagram with seven states and all possible state transitions. The remaining potential state transitions (i.e., the arrows connecting two states that are NOT drawn in this diagram) are impossible. For each of these impossible transitions, briefly explain why.

Question 2: Concurrency: Mutual Exclusion and Synchronization (10 marks)

Consider the following program:

```
const n = 50;
int tally;
void total()
{
    int count;
    for (count = 1; count <= n; count++) {
        Tally++;
    }
}
void main()
{
    tally = 0;
    parbegin (total(), total());
    write(tally);
}
```

1. Determine the proper lower and upper bound on the final value of the shared variable `tally` output by this concurrent program. Assume processes can execute at any relative speed and that a value can only be incremented after it has been loaded into a register by a separate machine instruction.
2. Suppose that an arbitrary number N of these processes are permitted to execute in parallel under the assumptions of part (1). What effect will this modification have on the range of final values of `tally`?

Question 3. Deadlocks (10 marks)

1. A computer has six tape drives, with n processes competing for them. Each process may need two drives. For which values of n is the system deadlock free?

2. A system has four processes and five allocatable resources. The current allocation and maximum needs are as follows:

AVAIL = 0 0 x 1 1

	1 0 2 1 1		1 1 2 1 3
	2 0 1 1 0		2 2 2 1 0
HAVE =	1 1 0 1 0	MAX =	2 1 3 1 0
	1 1 1 1 0		1 1 2 2 1

What is the smallest value of x for which this is a safe state? Explain your answer!

3. In a real computer system, neither the resources available nor the demands of processes for resources are consistent over long periods (months). Resources break or are replaced, new processes come and go, new resources are bought and added to the system. If deadlock is controlled by the banker's algorithm, which of the following changes can be made safely (without introducing the possibility of deadlock), and under what circumstances?
- Increase Available (add new resources)
 - Decreases Available (remove resources permanently from system)
 - Increase Max for one process
 - Decrease Max for one process
 - Increase the number of processes
 - Decrease the number of processes

Question 4. Memory Management (10 marks)

A pure paging system (no segmentation) has a page size of 512 words, a virtual memory of 512 pages numbered 0 through 511, and a physical memory of 10 frames numbered 0 through 9. The current content of physical memory is as follows:

Physical Address	Content
0
...
1536	start of Page 34
2048	start of Page 9
...	...
3072	start of Page Table
3584	start of Page 65
...
4608	start of Page 10
...

- a) Assuming that page tables contain frame numbers (rather than physical memory addresses), show the current content of the page table.

b) Show the content of the page table after page 49 is loaded at location 0 and page 34 is replaced by page 12.

c) What physical address is referenced by the virtual address 4613?