

**CS 5631: Operating Systems (4)****Catalog Description:**

Operating system as a resource manager. Processor management and scheduling, deadlocks, concurrency, memory management, protection and security, as applied in modern operating systems. Concepts are illustrated via laboratory assignments which heavily emphasize concurrency.

**Textbook:** Silbershatz, Galvin, and Gagne, *Operating Systems Concepts, 8<sup>th</sup> Ed.*, John Wiley & Sons, 2009.

**Course Goals:**

The objective of this course is to present the operating system as the resource manager of today's large, complex computing systems. The resources to be managed include memory, processors, devices, and information. The emphasis of this course is processor, memory and virtual memory management; concurrency; scheduling; deadlocks; and security and protection. The most important of these concepts are illustrated by programming assignments and case studies.

**Prerequisites by Course & Topic**

CS 2511: Software Analysis & Design – proficiency in object-oriented design and coding, a systematic approach to testing and debugging, ability to work successfully on a team  
 CS 2521: Computer Organization & Architecture - understanding how programs and data are stored and represented in a computer system

**Major Topics Covered in the Course**

- Processes & Scheduling
- Concurrency
- Deadlocks
- Memory Management
- Virtual Memory Management
- Protection & Security
- Case Studies
- File Systems
- Mass Storage of I/O Systems

**Class/Laboratory Schedule:** Lecture: 3 hours per week, Laboratory: 1

**Course Outcomes**

1. Understand the basic issues of concurrency (synchronization, mutual exclusion), using processes and threads as basic units.
2. Apply basic OS vocabulary and understand the evolutionary nature of operating systems.
3. Analyze under what conditions deadlock occurs, understand how to detect and prevent it.
4. Comprehend how various memory management systems evolved over time (culminating with current day systems, i.e., demand paging and segmentation), their designs and implementations.
5. Understand the measures used to enhance security in operating systems.
6. Apply the ability to work in a team environment to solve challenging problems.

**Program Outcomes Assessment via this Course**

UMD Computer Science Department program outcomes are assessed by identifying performance criteria for each of the program outcomes, and assessing those performance criteria in various ways. Below are listed the performance criteria to be assessed in this course.

- 3a. Demonstrate understanding for the characteristics typical of modern computing systems
- 3b. Understand the challenges posed by ongoing changes in computer systems organization
- 3c. Demonstrate understanding for heterogeneous, interconnected computer systems

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 a. . Illustrate orally in class discussion and in written form on both homework and tests the use of appropriate OS terminology. .  
 a. . Given a set scenario, correctly apply the Banker's algorithm to determine whether or not deadlock occurs. .

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 a. . Understand program threats, how they are constructed, and how they may be defeated. .  
 <#>Meet with fellow team members to design and properly implement the solutions to problems. .

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Course Outcomes

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**Relationship to Program Outcomes**

This course contributes to the following Program Outcomes:

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5. *Students understand the application of programming languages in computer systems.* Students program using the C++ and Java languages. C++ (and C) are used as systems programming languages.

6. *Students can apply computer science principles and practices to a variety of problems.* Students learn the basics of file system design, and multi-threaded programming, and apply these principles to their multi-threaded file system.

7. *Students can work effectively in teams, and*

8. *Students can communicate effectively.* Students work in teams on the file system labs.

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#### Assessment of Performance Criteria

CS 5631 is expected to assess the following program criterion:

3. Students understand the fundamentals of computer systems organization
  - a. Demonstrate understanding for the characteristics typical of modern computing systems
  - b. Understand the challenges posed by ongoing changes in computer systems organization
  - c. Demonstrate understanding for heterogeneous, interconnected computer systems
  
7. Students can work effectively in teams
  - a. Work with team members to specify and develop medium-scale, new software systems (a few thousand or more lines of code and documentation)
  - b. Work with team members to specify and develop software systems by extending frameworks or enhancing existing code and documentation

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#### Assessment Plan for Course:

This course is assessed every third year by the instructor and a course assessment document covering all of the course outcomes and their effect on the program outcomes is prepared.

- 7a. Work with team members to specify and develop medium-scale, new software
- 7b. Work with team members to specify and develop software systems by extending frameworks or enhancing existing code and documentation

**Program Outcomes Supported by this Course**

- 2. Students can design, develop, and analyze significant software systems.
- 3. Students understand the fundamentals of computer systems organization.
- 5. Students understand the application of programming languages in computer systems
- 6. Students can apply computer science principles and practices to a variety of problems
- 7. Students can work effectively in teams
- 8. Students can communicate effectively.

**Assessment Plan for Course:**

This course is assessed every third year by the instructor and a course assessment document covering course outcomes and the listed performance criteria is prepared.

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