**Sana'a University**
**Faculty of Engineering**
**Electrical Engineering Department**
**B.Sc. of Computer and Control Engineering**

# 41. Course Specification of Operating Systems

## I. Course Identification and General Information:

| | | | | | | |
|---|---|---|---|---|---|---|
| **1.** | Course Title: | Operating Systems | | | | |
| **2.** | Course Code & Number: | CCE321 | | | | |
| **3.** | Credit hours: | C.H | | | | Total C.Hs |
| | | Th. | Tu. | Pr. | Tr. | |
| | | 2 | - | 2 | - | 3 |
| **4.** | Study level/ semester at which this course is offered: | $4^{th}$ Year – $1^{st}$ Semester | | | | |
| **5.** | Pre-requisite (if any): | Computer Skills (UR003),<br>Programming Language 3 (Java) (CCE244) | | | | |
| **6.** | Co-requisite (if any): | None. | | | | |
| **7.** | Program(s) in which the course is offered: | Electrical Engineering – Computer and Control section | | | | |
| **8.** | Language of teaching the course: | English | | | | |
| **9.** | Location of teaching the course: | Electrical Engineering Department, Faculty of Engineering | | | | |
| **10.** | Prepared By: | Asst. Prof. Dr. Sami Al-Maqtari | | | | |
| **11.** | Date of Approval: | | | | | |

## II. Course Description:

This course aims to provide students with basic fundamental and concepts related to Operating Systems and its applications & managements to variant hardware systems and technologies like computers, notepads, smart mobiles, database systems and distributed systems. It covers the following subjects; An overview on operating systems and computer architecture/organization, Processes and CPU scheduling techniques, Concurrency and threads, thread scheduling, multiprocessor scheduling, Process synchronization, deadlocks, Memory managements techniques, Storage managements & RAIDs technologies, file

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| concepts, and disk structure and management. Throughout computer-based lab works, students will develop their hardware/software development and programming skills as well as the problem-solving skill related to operating systems. |

| | **III. Course Intended learning outcomes (CILOs) of the course** | **Referenced PILOs** |
|---|---|---|
| **a1** | Define the fundamentals of Operating Systems such as roles, structures, types, the concept of process management and CPU scheduling, multiprogramming/multithreading, and deadlocks. | A1 |
| **a2** | Acquire knowledge of memory types, management, paging system, virtual memory and file system management. | A3 |
| **b1** | Analyze the different process scheduling algorithms to some aspects of racing conditions and their solutions, as well as analyzing different techniques of memory and file management. | B1, B2 |
| **b2** | Consider the importance of the different functions of operating systems in modern computer systems. | B4 |
| **c1** | Test the various process scheduling algorithms solutions and the different approaches for multiprogramming race condition solutions. | C1, C2 |
| **c2** | Implement different CPU scheduling methods and memory & disk management techniques using computer programming for performance measurements and comparison. | C3, C4 |
| **d1** | Develop problem-solving skills related to operating systems evaluation and applying them to different software development problems. | D2 |
| **d2** | Communicate effectively both orally or in written forms. | D4 |

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| **(A) Alignment Course Intended Learning Outcomes of Knowledge and Understanding to Teaching Strategies and Assessment Strategies:** | | |
|---|---|---|
| Course Intended Learning Outcomes | Teaching strategies | Assessment Strategies |
| **a1-** Define the fundamentals of Operating Systems such as roles, structures, types, the concept of process management and CPU scheduling, multiprogramming/multithreading, and deadlocks. | ▪ Active Lectures.<br>▪ Laboratory. | ▪ Examinations,<br>▪ Homework. |
| **a2-** Acquire knowledge of memory types, management, paging system, virtual memory and file system management. | ▪ Active Lectures.<br>▪ Laboratory.<br>▪ Projects | ▪ Examinations,<br>▪ Homework,<br>▪ Project Reports |

| **(B) Alignment Course Intended Learning Outcomes of Intellectual Skills to Teaching Strategies and Assessment Strategies:** | | |
|---|---|---|
| Course Intended Learning Outcomes | Teaching strategies | Assessment Strategies |
| **b1-** Analyze the different process scheduling algorithms to some aspects of racing conditions and their solutions, as well as analyzing different techniques of memory and file management. | ▪ Active Lectures.<br>▪ Laboratory.<br>▪ Projects | ▪ Examinations,<br>▪ Homework,<br>▪ laboratory reports,<br>▪ Project Reports. |
| **b2-** Consider the importance of the different functions of operating systems in modern computer systems. | ▪ Active Lectures.<br>▪ Laboratory.<br>▪ Projects | ▪ Examinations,<br>▪ Homework,<br>▪ laboratory reports,<br>▪ Project Reports. |

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| **(C) Alignment Course Intended Learning Outcomes of Professional and Practical Skills to Teaching Strategies and Assessment Strategies:** | | |
|---|---|---|
| Course Intended Learning Outcomes | Teaching strategies | Assessment Strategies |
| **c1-** Test the various process scheduling algorithms solutions and the different approaches for multiprogramming race condition solutions. | ▪ Laboratory,<br>▪ Projects,<br>▪ Small Group. | ▪ Homework,<br>▪ Laboratory reports,<br>▪ Individual & group Project Reports. |
| **c2-** Implement different CPU scheduling methods and memory & disk management techniques using computer programming for performance measurements and comparison. | ▪ Laboratory,<br>▪ Projects,<br>▪ Small Group. | ▪ Presentations,<br>▪ Homework,<br>▪ Laboratory reports,<br>▪ Individual & group Project Reports. |

| **(D) Alignment Course Intended Learning Outcomes of Transferable Skills to Teaching Strategies and Assessment Strategies:** | | |
|---|---|---|
| Course Intended Learning Outcomes | Teaching strategies | Assessment Strategies |
| **d1-** Develop problem-solving skills related to operating systems evaluation and applying them to different software development problems. | ▪ Laboratory,<br>▪ Projects. | ▪ Presentations,<br>▪ Individual & group Project Reports. |
| **d2-** Communicate effectively both orally or in written forms. | ▪ Laboratory,<br>▪ Projects. | ▪ Presentations,<br>▪ Laboratory reports,<br>▪ Individual & group Project Reports. |

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## IV. Course Content:

### A- Theoretical Aspect

| Order | Units/Topics List | Learning Outcomes | Sub Topics List | Number of Weeks | Contact hours |
|---|---|---|---|---|---|
| **1.** | Introduction | a1, b2 | - What Operating Systems Do<br>- Computer-System Organization<br>- Computer-System Architecture<br>- Operating-System Structure<br>- Operating-System Operations<br>- Process Management<br>- Memory Management<br>- Storage Management<br>- Protection and Security<br>- Kernel Data Structures<br>- Computing Environments<br>- Open-Source Operating Systems | 2 | 4 |
| **2.** | Operating-System Structures | a1, b2 | - Operating-System Services<br>- User and Operating-System Interface<br>- System Calls<br>- Types of System Calls<br>- System Programs<br>- Operating-System Design and Implementation<br>- Operating-System Structure | 2 | 4 |

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| | | | - Operating-System Debugging<br>- Operating-System Generation<br>- System Boot | | |
| **3.** | Processes | a1, b1, b2 | - Process Concept<br>- Process Scheduling<br>- Operations on Processes<br>- Inter-process Communication (IPC)<br>- Examples of IPC Systems<br>- Communication in Client-Server Systems | 1 | 2 |
| **4.** | Threads | a1, b1, b2 | - Overview<br>- Multicore Programming<br>- Multithreading Models<br>- Thread Libraries<br>- Implicit Threading<br>- Threading Issues | 1 | 2 |
| **5.** | Process Synchronization | a1, b1, b2 | - Background<br>- The Critical-Section Problem<br>- Peterson's Solution<br>- Synchronization Hardware<br>- Mutex Locks<br>- Semaphores. | 1 | 2 |
| **6.** | Process Synchronization (Cont.) | a1, b1, b2 | - Classic Problems of Synchronization<br>- Monitors<br>- Synchronization Examples<br>- Alternative Approaches | 1 | 2 |

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| | | | - Deadlocks. | | |
| **7.** | CPU Scheduling | a1, b1, b2 | - Basic Concepts<br>- Scheduling Criteria<br>- Scheduling Algorithms<br>- Thread Scheduling<br>- Multiple-Processor Scheduling<br>- Real-Time CPU Scheduling<br>- Operating-System Examples<br>- Algorithm Evaluation | 2 | 4 |
| **8.** | Memory Management | a2, b1, b2 | - Background<br>- Swapping<br>- Contiguous Memory Allocation<br>- Segmentation<br>- Paging<br>- Structure of the Page Table | 1 | 2 |
| **9.** | Virtual Memory | a2, b1, b2 | - Background<br>- Demand Paging<br>- Copy-on-Write<br>- Page Replacement<br>- Allocation of Frames<br>- Thrashing<br>- Memory-Mapped Files<br>- Allocating Kernel Memory | 1 | 2 |
| **10.** | Storage Management | a2, b1, b2 | - Overview of Mass-Storage Structure<br>- Disk Structure<br>- Disk Attachment<br>- Disk Scheduling | 1 | 2 |

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|---|---|---|---|---|---|
| | | | - Disk Management<br>- Swap-Space Management<br>- RAID Structure<br>- Stable-Storage Implementation | | |
| **11.** | File-System Interface | a2, b1, b2 | - File Concept<br>- Access Methods<br>- Directory and Disk Structure<br>- File-System Mounting<br>- File Sharing<br>- Protection | 1 | 2 |
| **Number of Weeks /and Units Per Semester** | | | | **14** | **28** |

## B- Practical Aspect:

| Order | Tasks/ Experiments | Number of Weeks | Contact hours | Learning Outcomes |
|---|---|---|---|---|
| **1.** | Computer-based lab preparation & Software installations.<br>Basic operating Systems fundamentals, types and applications.<br>Preparing & Distributing students in small groups of 2 or 3 members for choosing project's subjects and start working from the 4th week to the 13th week. | 1 | 2 | a1, b2, d1 |
| **2.** | Working with Linux O.S Environment,<br>Defining & Demonstrating list of Linux's instructions for making, altering directories, working with disk and files in Linux. | 2 | 4 | a1, b1, b2, c1, c2, d1 |

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| | Adding some functionalities or building user Log illustrating security in Linux. | | | |
| **3.** | An Overview on Process, PCB and Multithreads in Linux and/or Windows operating Systems, Process & Multithreads Demonstrating & Programming using C++/Java. | 2 | 4 | a1, b1, b2, c2, d1 |
| **4.** | Process Synchronizations Problems & Solutions using Programming. | 2 | 4 | a1, b1, b2, c2, d1 |
| **5.** | CPU Scheduling Techniques & Deadlocks: Performance evaluation of different CPU Scheduling algorithms to different O.Ss environments such as Linux, Windows and real-time, by using computer programming and preparing short reports comparing different CPU Scheduling. | 2 | 4 | a1, b1, c1, c2, d1, d2 |
| **6.** | Memory Management Techniques Simulation & Programming | 1 | 2 | a2, b2, c1, c2, d1 |
| **7.** | Storage Management's Algorithms Simulation & Programming | 1 | 2 | a2, b2, c2, d1 |
| **8.** | File System Management Simulation & Programming | 1 | 2 | b2, c2, d1 |
| **9.** | Term Project Presentations | 1 | 2 | a1, a2, b1, b2, c1, c2, d1, d2 |
| **10.** | Final Lab Exam | 1 | 2 | a1, a2, b1, b2, c1, c2, d1 |
| **Number of Weeks /and Units Per Semester** | | **14** | **28** | |

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## V. Teaching strategies of the course:

- Active Lectures,
- Laboratory,
- Projects,
- Small Group.

## VI. Assignments & Reports:

| No | Assignments | Aligned CILOs(symbols) | Week Due | Mark |
|---|---|---|---|---|
| 1. | Short Reports on Open source, non-open source & Real Time Operating Systems | a1, b2, d1, d2 | 3rd & 4th | 2 |
| 2. | Process & Multithreading and Process Synchronization with Reports | a1, b1, b2, c1, c2, d1 | 5th to 9th | 2 |
| 3. | Homework on CPU Scheduling with short Report | a1, b1, b2, c1, c2, d1, d2 | 10th & 11th | 2 |
| 4. | Homework on Memory & Storage Management with short Report | a1, a2, b1, b2, c1, d1, d2 | 12th & 13th | 1 |
| 5. | Lab Reports | a1, a2, b1, b2, c1, c2, d1, d2 | 3rd to 12th | 8 |
| | **Total** | | | **15** |

## VII. Schedule of Assessment Tasks for Students During the Semester:

| No. | Assessment Method | Week Due | Mark | Proportion of Final Assessment | Aligned Course Learning Outcomes |
|---|---|---|---|---|---|
| 1. | Assignments & Reports | 3rd to 14th | 15 | 10% | a1, a2, b1, b2, c1, c2, d1, d2 |

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| **2.** | Quizzes | Once per a month | 10 | 6.67% | a1, a2, b1, b2, c1, d1 |
| **3.** | Mid-Term Exam (theoretical) | 8th | 20 | 13.33% | a1, b1, b2, |
| **4.** | Final Exam (practical including Term Project Evaluation) | 13th & 14th | 30 | 20% | a1, a2, b1, b2, c1, c2, d1, d2 |
| **5.** | Final Exam (theoretical) | 16th | 75 | 50% | a1, a2, b1, b2 |
| | **Total** | | **150** | **100%** | |

## VIII. Learning Resources:

*Written in the following order: (Author - Year of publication – Title – Edition – Place of publication – Publisher).*

**1- Required Textbook(s) (maximum two).**

1- Abraham Silberschatz & Peter B. Galvin – 2018 - Operating System Concepts - 10th edition – Wiley

**2- Essential References.**

1- Naresh Chauhan – 2016 - Principles of Operating Systems - Oxford University Press

**3- Electronic Materials and Web Sites *etc*.**

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## IX. Course Policies:

**1. Class Attendance:**
- The students should have more than 75% of attendance according to rules and regulations of the faculty.

**2. Tardy:**
- The students should respect the timing of attending the lectures. They should attend within 15 minutes from starting of the lecture.

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| **3.** | **Exam Attendance/Punctuality:**<br>- The student should attend the exam on time. The punctuality should be implemented according to rules and regulations of the faculty for mid-term exam and final exam. |
| **4.** | **Assignments & Projects:**<br>- The assignment is given to the students after each chapter; the student has to submit all the assignments for checking on time. |
| **5.** | **Cheating:**<br>- If any cheating occurred during the examination, the student is not allowed to continue and he has to face the examination committee for enquiries. |
| **6.** | **Plagiarism:**<br>- If one student attends the exam on another behalf; he will be dismissed from the faculty according to the policy, rules and regulations of the university. |
| **7.** | **Other policies:**<br>- All the teaching materials should be kept out the examination hall and mobile phones are not allowed.<br>- Mutual respect should be maintained between the student and his teacher and also among students. Failing in keeping this respect is subject to the policy, rules and regulations of the university. |

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| **Reviewed By** | **Vice Dean for Academic Affairs and Post Graduate Studies: Asst. Prof. Dr. Tarek A. Barakat**<br>**President of Quality Assurance Unit: Assoc. Prof. Dr. Mohammed Algorafi**<br>**Name of Reviewer from the Department: Assoc. Prof. Dr. Farouk Al-Fuhaidy** |
| | **Deputy Rector for Academic Affairs Asst. Prof. Dr. Ibrahim AlMutaa**<br>**Assoc. Prof. Dr. Ahmed Mujahed**<br>**Asst. Prof. Dr. Munasar Alsubri** |

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# 41. Course Plan of Operating Systems

## I. Information about Faculty Member Responsible for the Course:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Name of Faculty Member** | Dr. Sami AL-MAQTARI | **Office Hours** | | | | | |
| **Location& Telephone No.** | 771010885 | **SAT** | **SUN** | **MON** | **TUE** | **WED** | **THU** |
| **E-mail** | dr.samiaziz@gmail.com | | | 10-12 | | | |

## II. Course Identification and General Information:

| | | | | | | |
|---|---|---|---|---|---|---|
| **1.** | Course Title: | Operating Systems | | | | |
| **2.** | Course Code & Number: | CCE321 | | | | |
| **3.** | Credit hours: | C.H | | | | Total |
| | | Th. | Tu. | Pr. | Tr. | |
| | | 2 | - | 2 | - | 3 |
| **4.** | Study level/ semester at which this course is offered: | $4^{th}$ Year – $1^{st}$ semester | | | | |
| **5.** | Pre-requisite (if any): | Computer Skills (UR003), Programming Language 3 (Java) (CCE244) | | | | |
| **6.** | Co-requisite (if any): | None. | | | | |
| **7.** | Program(s) in which the course is offered: | Electrical Engineering – Computer and Control section | | | | |
| **8.** | Language of teaching the course: | English | | | | |
| **9.** | System of Study: | Annual | | | | |
| **10.** | Mode of delivery: | Collective and individual learning | | | | |
| **11.** | Location of teaching the course: | Electrical Engineering Department, Faculty of Engineering | | | | |

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## III. Course Description:

This course aims to provide students with basic fundamental and concepts related to Operating Systems and its applications & managements to variant hardware systems and technologies like computers, notepads, smart mobiles, database systems and distributed systems. It covers the following subjects; An overview on operating systems and computer architecture/organization, Processes and CPU scheduling techniques, Concurrency and threads, thread scheduling, multiprocessor scheduling, Process synchronization, deadlocks, Memory managements techniques, Storage managements & RAIDs technologies, file concepts, and disk structure and management. Throughout computer-based lab works, students will develop their hardware/software development and programming skills as well as the problem-solving skill related to operating systems.

## IV. Intended learning outcomes (ILOs) of the course:

- Brief summary of the knowledge or skill the course is intended to develop**:**

**1-** Define the fundamentals of Operating Systems such as roles, structures, types, the concept of process management and CPU scheduling, multiprogramming/multithreading, and deadlocks.

**2-** Acquire knowledge of memory types, management, paging system, virtual memory and file system management.

**3-** Analyze the different process scheduling algorithms to some aspects of racing conditions and their solutions, as well as analyzing different techniques of memory and file management.

**4-** Consider the importance of the different functions of operating systems in modern computer systems.

**5-** Test the various process scheduling algorithms solutions and the different approaches for multiprogramming race condition solutions.

**6-** Implement different CPU scheduling methods and memory & disk management techniques using computer programming for performance measurements and comparison.

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| **7-** | Develop problem-solving skills related to operating systems evaluation and applying them to different software development problems. |
| **8-** | Communicate effectively both orally or in written forms. |

## V. Course Content:

### A. Theoretical Aspect

| Order | Units/Topics List | Sub Topics List | Number of Weeks | Contact hours |
|---|---|---|---|---|
| **1.** | Introduction | - What Operating Systems Do<br>- Computer-System Organization<br>- Computer-System Architecture<br>- Operating-System Structure<br>- Operating-System Operations<br>- Process Management<br>- Memory Management<br>- Storage Management<br>- Protection and Security<br>- Kernel Data Structures<br>- Computing Environments<br>- Open-Source Operating Systems | 1st ,2nd | 4 |
| **2.** | Operating-System Structures | - Operating-System Services<br>- User and Operating-System Interface<br>- System Calls<br>- Types of System Calls<br>- System Programs<br>- Operating-System Design and Implementation<br>- Operating-System Structure | 3rd ,4th | 4 |

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| | | - Operating-System Debugging<br>- Operating-System Generation<br>- System Boot | | |
| **3.** | Processes | - Process Concept<br>- Process Scheduling<br>- Operations on Processes<br>- Inter-process Communication (IPC)<br>- Examples of IPC Systems<br>- Communication in Client-Server Systems | 5th | 2 |
| **4.** | Threads | - Overview<br>- Multicore Programming<br>- Multithreading Models<br>- Thread Libraries<br>- Implicit Threading<br>- Threading Issues | 6th | 2 |
| **5.** | Process Synchronization | - Background<br>- The Critical-Section Problem<br>- Peterson's Solution<br>- Synchronization Hardware<br>- Mutex Locks<br>- Semaphores. | 7th | 2 |
| **6.** | Mid Term Exam | - ALL Previous Topics | 8th | 2 |
| **7.** | Process Synchronization (Cont.) | - Classic Problems of Synchronization<br>- Monitors<br>- Synchronization Examples<br>- Alternative Approaches<br>- Deadlocks. | 9th | 2 |
| **8.** | CPU Scheduling | - Basic Concepts<br>- Scheduling Criteria | 10th ,11th | 4 |

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| | | - Scheduling Algorithms<br>- Thread Scheduling<br>- Multiple-Processor Scheduling<br>- Real-Time CPU Scheduling<br>- Operating-System Examples<br>- Algorithm Evaluation | | |
| **9.** | Memory Management | - Background<br>- Swapping<br>- Contiguous Memory Allocation<br>- Segmentation<br>- Paging<br>- Structure of the Page Table | 12th | 2 |
| **10.** | Virtual Memory | - Background<br>- Demand Paging<br>- Copy-on-Write<br>- Page Replacement<br>- Allocation of Frames<br>- Thrashing<br>- Memory-Mapped Files<br>- Allocating Kernel Memory | 13th | 2 |
| **11.** | Storage Management | - Overview of Mass-Storage Structure<br>- Disk Structure<br>- Disk Attachment<br>- Disk Scheduling<br>- Disk Management<br>- Swap-Space Management<br>- RAID Structure<br>- Stable-Storage Implementation | 14th | 2 |
| **12.** | File-System Interface | - File Concept<br>- Access Methods | 15th | 2 |

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| | | - Directory and Disk Structure<br>- File-System Mounting<br>- File Sharing<br>- Protection | | |
| **13.** | Final Exam | - ALL Topics | 16th | 2 |
| **Number of Weeks /and Units Per Semester** | | | **16** | **32** |

| **B. Practical Aspect:** | | | |
|---|---|---|---|
| **Order** | **Tasks/ Experiments** | **Number of Weeks** | **Contact hours** |
| **1.** | Computer-based lab preparation & Software installations.<br>Basic operating Systems fundamentals, types and applications.<br>Preparing & Distributing students in small groups of 2 or 3 members for choosing project's subjects and start working from the 4th week to the 13th week. | 1st | 2 |
| **2.** | Working with Linux O.S Environment,<br>Defining & Demonstrating list of Linux's instructions for making, altering directories, working with disk and files in Linux.<br>Adding some functionalities or building user Log illustrating security in Linux. | 2nd ,3rd | 4 |
| **3.** | An Overview on Process, PCB and Multithreads in Linux and/or Windows operating Systems,<br>Process & Multithreads Demonstrating & Programming using C++/Java. | 4th ,5th | 4 |
| **4.** | Process Synchronizations Problems & Solutions using Programming. | 6th ,7th | 4 |
| **5.** | CPU Scheduling Techniques & Deadlocks: | 8th ,9th | 4 |

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|---|---|---|---|
| | Performance evaluation of different CPU Scheduling algorithms to different O.Ss environments such as Linux, Windows and real-time, by using computer programming and preparing short reports comparing different CPU Scheduling. | | |
| **6.** | Memory Management Techniques Simulation & Programming | 10th | 2 |
| **7.** | Storage Management's Algorithms Simulation & Programming | 11th | 2 |
| **8.** | File System Management Simulation & Programming | 12th | 2 |
| **9.** | Term Project Presentations | 13th | 2 |
| **10.** | Final Lab Exam | 14th | 2 |
| **Number of Weeks /and Units Per Semester** | | **14** | **28** |

## VI. Teaching strategies of the course:

- Active Lectures,
- Laboratory,
- Projects,
- Small Group.

## VII. Assignments & Reports:

| No | Assignments | Aligned CILOs(symbols) | Week Due | Mark |
|---|---|---|---|---|
| **1.** | Short Reports on Open source, non-open source & Real Time Operating Systems | a1, b2, d1, d2 | 3rd & 4th | 2 |
| **2.** | Process & Multithreading and Process Synchronization with Reports | a1, b1, b2, c1, c2, d1 | 5th to 9th | 2 |
| **3.** | Homework on CPU Scheduling with short Report | a1, b1, b2, c1, c2, d1, d2 | 10th & 11th | 2 |

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| **4.** | Homework on Memory & Storage Management with short Report | a1, a2, b1, b2, c1, d1, d2 | 12th & 13th | 1 |
| **5.** | Lab Reports | a1, a2, b1, b2, c1, c2, d1, d2 | 3rd to 12th | 8 |
| | **Total** | | | **15** |

## VIII. Schedule of Assessment Tasks for Students During the Semester:

| No. | Assessment Method | Week Due | Mark | Proportion of Final Assessment |
|---|---|---|---|---|
| **1.** | Assignments & Reports | 3rd to 14th | 15 | 10% |
| **2.** | Quizzes | Once per a month | 10 | 6.67% |
| **3.** | Mid-Term Exam (theoretical) | 8th | 20 | 13.33% |
| **4.** | Final Exam (practical including Term Project Evaluation) | 13th & 14th | 30 | 20% |
| **5.** | Final Exam (theoretical) | 16th | 75 | 50% |
| | **Total** | | **150** | **100%** |

## IX. Learning Resources:

*Written in the following order: (Author - Year of publication – Title – Edition – Place of publication – Publisher).*

**1- Required Textbook(s) (maximum two).**

1. Abraham Silberschatz & Peter B. Galvin – 2018 - Operating System Concepts - 10th edition – Wiley

**2- Essential References.**

1. Naresh Chauhan – 2016 - Principles of Operating Systems - Oxford University Press

**3- Electronic Materials and Web Sites *etc*.**

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| | X. Course Policies: |
|---|---|
| **1.** | **Class Attendance:**<br>- The students should have more than 75% of attendance according to rules and regulations of the faculty. |
| **2.** | **Tardy:**<br>- The students should respect the timing of attending the lectures. They should attend within 15 minutes from starting of the lecture. |
| **3.** | **Exam Attendance/Punctuality:**<br>- The student should attend the exam on time. The punctuality should be implemented according to rules and regulations of the faculty for mid-term exam and final exam. |
| **4.** | **Assignments & Projects:**<br>- The assignment is given to the students after each chapter; the student has to submit all the assignments for checking on time. |
| **5.** | **Cheating:**<br>- If any cheating occurred during the examination, the student is not allowed to continue and he has to face the examination committee for enquires. |
| **6.** | **Plagiarism:**<br>- If one student attends the exam on another behalf; he will be dismissed from the faculty according to the policy, rules and regulations of the university. |
| **7.** | **Other policies:**<br>- All the teaching materials should be kept out the examination hall and mobile phones are not allowed.<br>- Mutual respect should be maintained between the student and his teacher and also among students. Failing in keeping this respect is subject to the policy, rules and regulations of the university. |

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