

Republic of Yemen

Ministry of Higher Education & Scientific Research

Council of Academic Accreditation & Quality Assurance of Higher
Education(CAQA)

21 September University for Medical and
Applied Sciences



Faculty of Engineering and Computer
Department of Information Technology
Program of Information Technology
Course Specification of
Operating System
Course Code. (07.01. 712)

2024



T4: This Template is Developed and Approved by CAQA-Yemen, 2023

Prepared by:
Dr. Gameil Saad Hamzh

Reviewed by:
Dr. ----

Head of the Department:

Quality Unit: Dean

I. General Information:

1.	Course Title:	Operating System				
2.	Course Code:	07.01. 712				
3.	Credit Hours:	Credit Hours	Theory Contact Hours		Practical Contact Hours	
			Lecture	Tutorial/ Seminar	Lab	Clinical
		3	2	--	2	--
4.	Level/ Semester at which this Course is offered:	Level 2/ Semester 2				
5.	Pre –Requisite (if any):					
6.	Co –Requisite (if any):	non				
7.	Program (s) in which the Course is Offered:	Bachelor of Medical Information Technology				
8.	Language of Teaching the Course:	English				
9.	Location of Teaching the Course:	Faculty of Medical Technology				
10.	Prepared by:	Dr. Gameil Saad Hamzh				
11	Date and Number of Approval by Council:					

II. Course Description:

This course aims to introduce students to the concepts of operating systems including processes, threads, scheduling, memory management and file system. Students learn how OS controls and uses the hardware resources in efficient manner, besides, providing a suitable environment for user programs and applications. Course topics including OS structure, Process management, Multi-threaded, CPU scheduling, Process Synchronization, Deadlocks, Main memory management, virtual memory, and mass-storage management. Moreover, students expected to apply most OS tasks in Unix/Linux environment using C++ language.

III. Course Intended Learning Outcomes (CILOs) : Upon successful completion of the course, students will be able to:		Referenced PILOs	
A. Knowledge and Understanding:		I, A or E	
a1	Identify and describe the major terms, concepts and fundamentals of operating systems.		A1 Demonstrate an understanding of the essential facts, concepts, principles and theories related to the fundamental sciences and the field of Artificial Intelligence and Data Science.
a2	Understand the modern operating systems in terms of structures, design and implementations approaches, algorithms and techniques used to manage the processes, main memory, I/O devices.		A2 Recognize the recent trends of technology and its impacts on the individuals, organizations, and society in the area of Artificial Intelligence and Data Science.
a3	Explaining the different types of OS environments.		A3 Demonstrate a profound knowledge in utilizing and adapting computing tools, techniques, practices, and methods for solving the real-world computing problems.
B. Intellectual Skills:			
b1	Recognize a wide range of algorithms and techniques used in operating systems to control and manage the hardware and users tasks.		B1 Critically analyze complex computing problems using the basic concepts, principles, analytical and mathematical models, algorithms and software tools related to the field of Artificial Intelligence and Data Science.
C. Professional and Practical Skills:			

III. Course Intended Learning Outcomes (CILOs) : Upon successful completion of the course, students will be able to:		Referenced PILOs	
c1	Simulate the most algorithms and techniques of theory part using C++ language in Unix/Linux environment.	C1	Apply computer science theory, Artificial Intelligence and Data Science, and software development fundamentals to design and develop intelligent-based solutions.
	Build a mini shell and custom kernel of operating system.	C2	Design, implement, and test a computing-based solution to meet a given set of computing requirements in the context of Artificial Intelligence and Data Science.
D. Transferable Skills:			
d1	Retrieve new information and knowledge effectively using all alternatives learning resource.	D1	Function effectively individually, as a member, or leader of a team engaged in activities appropriate to the Artificial Intelligence and Data Science discipline to accomplish a common goal.
d2	Self-learning dependency.	D4	Engage in continuing professional development and lifelong learning as a computing professional.

(A) Alignment of Course Intended Learning Outcomes (Knowledge and Understanding) to Teaching Strategies and Assessment Methods:			
	Course Intended Learning Outcomes	Teaching Strategies	Assessment Strategies
a1	Identify and describe the major terms, concepts	<ul style="list-style-type: none"> Interactive lectures, Tutorials, 	<ul style="list-style-type: none"> Written tests (mid and final terms and quizzes),

	and fundamentals of operating systems.	<ul style="list-style-type: none"> ▪ Project\presentation\ seminar, ▪ Interactive class discussions, ▪ Exercises and home works, ▪ Directed self- study, ▪ Problem based learning, ▪ Team work (cooperative learning), ▪ Field visits. 	<ul style="list-style-type: none"> ▪ Short reports, ▪ Coursework activities assessment, ▪ Home works and assignments, ▪ Presentations.
a2	Understand the modern operating systems in terms of structures, design and implementations approaches, algorithms and techniques used to manage the processes, main memory, I/O devices.	<ul style="list-style-type: none"> ▪ Interactive lectures, ▪ Tutorials, ▪ Project\presentation\ seminar, ▪ Interactive class discussions, ▪ Exercises and home works, ▪ Directed self- study, ▪ Problem based learning, ▪ Team work (cooperative learning), ▪ Field visits. 	<ul style="list-style-type: none"> ▪ Written tests (mid and final terms and quizzes), ▪ Short reports, ▪ Coursework activities assessment, ▪ Home works and assignments, ▪ Presentations.
a3	Explaining the different types of OS environments.	<ul style="list-style-type: none"> ▪ Interactive lectures, ▪ Tutorials, ▪ Project\presentation\seminar, ▪ Interactive class discussions, ▪ Exercises and home works, ▪ Directed self- study, ▪ Problem based learning, ▪ Team work (cooperative learning), ▪ Field visits. 	<ul style="list-style-type: none"> ▪ Written tests (mid and final terms and quizzes), ▪ Short reports, ▪ Coursework activities assessment, ▪ Home works and assignments, ▪ Presentations.
(B) Alignment of Course Intended Learning Outcomes (Intellectual Skills) to Teaching Strategies and Assessment Methods:			
	Course Intended Learning Outcomes	Teaching Strategies	Assessment Strategies

b1	Recognize a wide range of algorithms and techniques used in operating systems to control and manage the hardware and users tasks.	<ul style="list-style-type: none"> ▪ Interactive lectures, ▪ Tutorials, ▪ Interactive class discussions, ▪ Exercises and home works, ▪ Laboratory\Practical experiments based session, ▪ Computer laboratory-based sessions, ▪ Directed self- study, ▪ Problem based learning, ▪ Team work (cooperative learning), ▪ Field visits. 	<ul style="list-style-type: none"> ▪ Written tests (mid and final terms and quizzes), ▪ Short reports, ▪ Lab\Project report ▪ Practical Lab performance assessment ▪ Coursework activities assessment, ▪ Home works and assignments, ▪ Presentations.
(C) Alignment of Course Intended Learning Outcomes (Professional and Practical Skills) to Teaching Strategies and Assessment Methods:			
	Course Intended Learning Outcomes	Teaching Strategies	Assessment Strategies
c1	Simulate the most algorithms and techniques of theory part using C++ language in Unix/Linux environment.	<ul style="list-style-type: none"> ▪ Project\presentation\seminar, ▪ Exercises and home works, ▪ Laboratory\Practical experiments based session, ▪ Computer laboratory-based sessions, ▪ Problem based learning, ▪ Team work (cooperative learning), ▪ Field visits. 	<ul style="list-style-type: none"> ▪ Lab\Project report ▪ Practical Lab performance assessment ▪ Coursework activities assessment, ▪ Home works and assignments.
c2	Build a mini shell and custom kernel of operating system.	<ul style="list-style-type: none"> ▪ Project\presentation\seminar, ▪ Exercises and home works, ▪ Laboratory\Practical experiments based session, ▪ Computer laboratory-based sessions, 	<ul style="list-style-type: none"> ▪ Lab\Project report ▪ Practical Lab performance assessment ▪ Coursework activities assessment, ▪ Home works and assignments.

		<ul style="list-style-type: none"> ▪ Problem based learning, ▪ Team work (cooperative learning), ▪ Field visits. 	
(D) Alignment of Course Intended Learning Outcomes (Transferable Skills) to Teaching Strategies and Assessment Methods:			
	Course Intended Learning Outcomes	Teaching Strategies	Assessment Strategies
d1	Retrieve new information and knowledge effectively using all alternatives learning resource.	<ul style="list-style-type: none"> ▪ Project\presentation\seminar, ▪ Interactive class discussions, ▪ Exercises and home works, ▪ Laboratory\Practical experiments based session, ▪ Computer laboratory-based sessions, ▪ Directed self- study, ▪ Problem based learning, ▪ Team work (cooperative learning). 	<ul style="list-style-type: none"> ▪ Written tests (mid and final terms and quizzes), ▪ Short reports, ▪ Lab\Project report ▪ Practical Lab performance assessment ▪ Coursework activities assessment, ▪ Home works and assignments, ▪ Presentations.
d2	Self-learning dependency.	<ul style="list-style-type: none"> ▪ Project\presentation\seminar, ▪ Interactive class discussions, ▪ Exercises and home works, ▪ Laboratory\Practical experiments based session, ▪ Computer laboratory-based sessions, ▪ Directed self- study, ▪ Problem based learning, ▪ Team work (cooperative learning). 	<ul style="list-style-type: none"> ▪ Written tests (mid and final terms and quizzes), ▪ Short reports, ▪ Lab\Project report ▪ Practical Lab performance assessment ▪ Coursework activities assessment, ▪ Home works and assignments, ▪ Presentations.

IV. Course Contents:

IV. Course Contents:					
A. Theoretical Aspect:					
No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours	Learning Outcomes (CILOs)
1	Introduction	<ul style="list-style-type: none"> – What is an Operating System? – Computer-System Organization – Computer-System Architecture – Operating-System Structure – Process Management – Memory Management – Storage Management – Protection and Security – Kernel Data Structures – Computing Environments – Open-Source Operating Systems 	2	4	a1
2	Operating-System Structures	<ul style="list-style-type: none"> – Operating System Services – User Operating System Interface – System Calls – Types of System Calls – System Programs – Operating System Design and Implementation – Operating System Structure – Operating System Debugging – Operating System Generation – System Boot 	1	2	a1,a2
3	Processes	<ul style="list-style-type: none"> – Process Concept – Process Scheduling – Operations on Processes – Inter-process Communication – Communication in Client-Server Systems 	1	2	a1,a2,b1

IV. Course Contents:					
4	Threads & Concurrency	<ul style="list-style-type: none"> – Overview – Multicore Programming – Multithreading Models – Thread Libraries – Implicit Threading – Threading Issues – Operating System Examples 	1	2	a1,a2,b1
5	CPU Scheduling	<ul style="list-style-type: none"> – Basic Concepts – Scheduling Criteria – Scheduling Algorithms – Thread Scheduling – Multiple-Processor Scheduling – Real-Time CPU Scheduling – Algorithm Evaluation 	2	2	a1,a2,b1
6	Mid-Term Theoretical Exam		1	2	a1,a2,b1
7	Main Memory	<ul style="list-style-type: none"> – Background – Swapping – Contiguous Memory Allocation – Segmentation – Paging – Structure of the Page Table 	1	2	a1,a2,b1
8	Virtual Memory	<ul style="list-style-type: none"> – Background – Demand Paging – Copy-on-Write – Page Replacement – Allocation of Frames – Thrashing – Memory-Mapped Files – Allocating Kernel Memory – Operating-System Examples 	2	4	a1,a2,b1
9	Mass-Storage Systems	<ul style="list-style-type: none"> – An overview – Disk Structure 	1	2	a1,a2,b1

IV. Course Contents:					
		<ul style="list-style-type: none"> – Disk Attachment – Disk Scheduling – Disk Management – Swap-Space Management – RAID Structure 			
10	I/O Systems	<ul style="list-style-type: none"> – Overview – I/O Hardware – Application I/O Interface – Kernel I/O Subsystem – Transforming I/O Requests to Hardware Operations – STREAMS Performance 	1	2	a1,a2,b1
11	Synchronization	<ul style="list-style-type: none"> – The Critical-Section Problem – Peterson’s Solution – Mutex Locks – Semaphores 	1	2	a1,a2,b1
12	Deadlock	<ul style="list-style-type: none"> – Classic Problems of Synchronization – Deadlock in Multithreaded Applications – Methods for Handling Deadlocks – Deadlock Prevention – Deadlock Avoidance – Deadlock Detection – Recovery from Deadlock 	1	2	a1,a2,b1
13	Final Theoretical Exam	–	1	2	a1, a2, b1,d2
Number of Weeks /and Units Per Semester			16	32	

B. Practical Aspect:				
No.	Tasks/ Experiments	Week Due	Contact Hours	Learning Outcomes (CLOs)

B. Practical Aspect:				
1	Computer Lab (Unix/Linux)/C++: - Introduction to Unix/Linux - Installation and configuration - Basic Unix/Linux commands	1	2	c1, d1
2	More Unix/Linux commands	2	2	c1, d1
3	- Shell Scripting Programming - Simulation of Unix/Linux commands	3	2	b1, c1, d1
4	- Processes Creation	4	2	b1, c1, d1
5	- Introduction to Threads Programming	5	2	b1, c1, d1
6	- CPU Scheduling Algorithms Programming	6	2	b1, c1, d1
7	- Mid-Term Practical Exam	7	2	b1, c1, d1, d2
8	- Unix/Linux file system and file security	8	2	b1, c1, d1
9	Main Memory Management	9	2	b1, c1, d1
10	- Virtual Memory Management	10	2	b1, c1, d1
11	- Multi-Threaded/Multi-Cores Programming	11	2	b1, c1, d1
12	- Mass-storage Scheduling Algorithms.	12	2	b1, c1, d1
13	- Synchronization and Deadlock	13	2	
14	Course Project: - Examples: Mini-shell, Custom Kernel, etc.	Starts from week 4	-	b1, c1, c2, d1, d2
15	- Final Practical Exam Including Project presentation & Evaluation	15	2	b1, c2, d1, d2
Number of Weeks /and Units Per Semester		15	30	



C. Tutorial Aspect:				
No.	Tutorial	Number of Weeks	Contact Hours	Learning Outcomes (CILOs)
1				
2				
Number of Weeks /and Units Per Semester				

V. Teaching Strategies of the Course:
<ul style="list-style-type: none"> - Interactive lectures, - Interactive class discussions, - Directed self- study, - Tutorials, - Exercises and home works, - Problem based learning, - Laboratory\Practical experiments based session, - Computer laboratory-based sessions, - Team work (group learning), - Project\presentation\seminar.

VI. Assessment Methods of the Course:
<ul style="list-style-type: none"> - Written tests (mid and final terms and quizzes), - Short reports, - Coursework activities assessment, - Home works and assignments, - Lab\Project report, - Practical Lab performance assessment, - Presentations.

VII. Assignments:				
No.	Assignments	Week Due	Mark	Aligned CLOs (symbols)
1	Assignment 1: (Operating-System concepts Structures, Processes, Threads & Concurrency, and CPU Scheduling)	6	5	a2, c1, d1
2	Assignment 2: (Main Memory, Virtual Memory, Mass-Storage Systems, and Disk Scheduling)	10	5	a2, b1, c1, d1
3	Assignment 3: (Project report)	13	5	d1, d2
Total			15	

VIII. 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	6, 10, 13	15	15%	a2, b1, c1, d1, d2
2	Quizzes 1 & 2	6, 12	5	5%	a1, a2, b1
3	Mid-Term Theoretical Exam	8	10	10%	a1, a2, b1
4	Mid-Term Practical Exam	9	10	10%	b1, c1, c2, d1, d2
5	Final Practical Exam including Project Presentation & Evaluation	15	10	10%	b1, c2, d1, d2
6	Final Theoretical Exam	16	50	50%	a1, a2, b1
Total			100	100%	

IX. Learning Resources:
<ul style="list-style-type: none"> 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 Baer Galvin, Greg Gagne, 2018, Operating Systems concepts, 10 th , USA, Wiley.
2-	Andrew S. Tanenbaum, Herbert Bos, 2015, modern operating systems, 4 th , USA, Pearson.
3-	Yashavant P. Kanetkar ,2003, Unix Shell Programming,
2- Essential References:	
1-	William Stallings, 2018, Operating Systems Internals and Design Principles, 9 th , USA, Pearson.
2-	Richard Petersen, 2008, Linux: The Complete Reference, 6 th , USA, McGraw-Hill.
3-	Kenneth H. Rosen, Douglas A. Host, etc., 2007, UNIX-The Complete Reference, 2 nd , USA, McGraw-Hill.
4-	Paul Cobbaut, 2015, Linux Fundamentals, Netsec BVBA.
3- Electronic Materials and Web Sites etc.:	
Websites:	
1-	https://github.com/aut-ce/CE303-OS/find/master .
2-	
Journals:	
3-	
Other Web Sources:	

X. Course Policies: (Based on the Uniform Students' By law (2007)	
1	Class Attendance: Class Attendance is mandatory. A student is considered absent and shall be banned from taking the final exam if his/her absence exceeds 25% of total classes.
2	Tardiness: A student will be considered late if he/she is not in class after 10 minutes of the start time of class.
3	Exam Attendance/Punctuality: No student shall be allowed to the exam hall after 30 minutes of the start time, and shall not leave the hall before half of the exam time has passed.
4	Assignments & Projects:



	Assignments and projects must be submitted on time. Students who delay their assignments or projects shall lose the mark allocated for the same.
5	Cheating: Cheating is an act of fraud that results in the cancelation of the student's exam or assignment. If it takes place in a final exam, the penalties stipulated for in the Uniform Students' Bylaw (2007) shall apply.
6	Forgery and Impersonation: Forgery/Impersonation is an act of fraud that results in the cancelation of the student's exam, assignment or project. If it takes place in a final exam, the penalties stipulated for in the Uniform Students' Bylaw (2007) shall apply.
7	Other policies: The University official regulations in force will be strictly observed and students shall comply with all rules and regulations of the examination set by the Department, Faculty and University Administration.



Faculty of Medical Technology
Department of Medical Information Technology
Program of Medical Information Technology
Course Specification of
Operating System
Course Code. (07.01. 712)

I. Information about Faculty Member Responsible for the Course:							
Name of Faculty Member:		Office Hours					
Location & Telephone No.:	---						
E-mail:	--@--	SAT	SUN	MON	TUE	WED	THU

202../2024

Information about Faculty Member Responsible for the Course:

Name of Faculty Member:		Office Hours					
Location & Telephone No.:							
E-mail:		SAT	SUN	MON	TUE	WED	THU

I. Course Identification and General Information:					
1	Course Title:	Operating System			
2	Course Code & Number:	07.01. 712			
3	Credit Hours:	Credit Hours	Theory Hours		Lab. Hours
			Lecture	Exercise	
		3	2		2
4	Study Level/ Semester at which this Course is offered:	Level 2/ Semester 2			
5	Pre -Requisite (if any):				
6	Co -Requisite (if any):	non			
7	Program (s) in which the Course is Offered:	Bachelor of Medical Information Technology			
8	Language of Teaching the Course:	English			
9	Study System:	Faculty of Medical Technology			
10	Mode of Delivery:	Dr.			
11	Location of Teaching the Course:				
12	Prepared by:				
13	Date of Approval:				

II. Course Description:

This course aims to introduce students to the concepts of operating systems including processes, threads, scheduling, memory management and file system. Students learn how OS controls and uses the hardware resources in efficient manner, besides, providing a suitable environment for user programs and applications. Course topics including OS structure, Process management, Multi-threaded, CPU scheduling, Process Synchronization, Deadlocks, Main memory management, virtual memory, and mass-storage management. Moreover, students expected to apply most OS tasks in Unix/Linux environment using C++ language.

III. Course Intended Learning Outcomes (CILOs) : Upon successful completion of the course, students will be able to:			Referenced PILOs
A. Knowledge and Understanding:		I, A or E	
a1	Identify and describe the major terms, concepts and fundamentals of operating systems.		A1
a2	Understand the modern operating systems in terms of structures, design and implementations approaches, algorithms and techniques used to manage the processes, main memory, I/O devices.		A2
a3	Explaining the different types of OS environments.		A3
B. Intellectual Skills:			
b1	Recognize a wide range of algorithms and techniques used in operating systems to control and manage the hardware and users tasks.		B1
C. Professional and Practical Skills:			
c1	Simulate the most algorithms and techniques of theory part using C++ language in Unix/Linux environment.		C1
c2	Build a mini shell and custom kernel of operating system.		C2
D. Transferable Skills:			
d1	Retrieve new information and knowledge effectively using all alternatives learning resource.		D1
d2	Self-learning dependency.		D4

(A) Alignment of Course Intended Learning Outcomes (Knowledge and Understanding) to Teaching Strategies and Assessment Methods:			
	Course Intended Learning Outcomes	Teaching Strategies	Assessment Strategies
a1	Identify and describe the major terms, concepts and fundamentals of operating systems.	<ul style="list-style-type: none"> ▪ Interactive lectures, ▪ Tutorials, ▪ Project\presentation\ seminar, ▪ Interactive class discussions, ▪ Exercises and home works, ▪ Directed self- study, ▪ Problem based learning, ▪ Team work (cooperative learning), ▪ Field visits. 	<ul style="list-style-type: none"> ▪ Written tests (mid and final terms and quizzes), ▪ Short reports, ▪ Coursework activities assessment, ▪ Home works and assignments, ▪ Presentations.
a2	Understand the modern operating systems in terms of structures, design and implementations approaches, algorithms and techniques used to manage the processes, main memory, I/O devices.	<ul style="list-style-type: none"> ▪ Interactive lectures, ▪ Tutorials, ▪ Project\presentation\ seminar, ▪ Interactive class discussions, ▪ Exercises and home works, ▪ Directed self- study, ▪ Problem based learning, ▪ Team work (cooperative learning), ▪ Field visits. 	<ul style="list-style-type: none"> ▪ Written tests (mid and final terms and quizzes), ▪ Short reports, ▪ Coursework activities assessment, ▪ Home works and assignments, ▪ Presentations.
a3	Explaining the different types of OS environments.	<ul style="list-style-type: none"> ▪ Interactive lectures, ▪ Tutorials, ▪ Project\presentation\seminar, ▪ Interactive class discussions, ▪ Exercises and home works, ▪ Directed self- study, ▪ Problem based learning, ▪ Team work (cooperative 	<ul style="list-style-type: none"> ▪ Written tests (mid and final terms and quizzes), ▪ Short reports, ▪ Coursework activities assessment, ▪ Home works and assignments, ▪ Presentations.

		learning), ▪ Field visits.	
(B) Alignment of Course Intended Learning Outcomes (Intellectual Skills) to Teaching Strategies and Assessment Methods:			
	Course Intended Learning Outcomes	Teaching Strategies	Assessment Strategies
b1	Recognize a wide range of algorithms and techniques used in operating systems to control and manage the hardware and users tasks.	<ul style="list-style-type: none"> ▪ Interactive lectures, ▪ Tutorials, ▪ Interactive class discussions, ▪ Exercises and home works, ▪ Laboratory\Practical experiments based session, ▪ Computer laboratory-based sessions, ▪ Directed self- study, ▪ Problem based learning, ▪ Team work (cooperative learning), ▪ Field visits. 	<ul style="list-style-type: none"> ▪ Written tests (mid and final terms and quizzes), ▪ Short reports, ▪ Lab\Project report ▪ Practical Lab performance assessment ▪ Coursework activities assessment, ▪ Home works and assignments, ▪ Presentations.
(C) Alignment of Course Intended Learning Outcomes (Professional and Practical Skills) to Teaching Strategies and Assessment Methods:			
	Course Intended Learning Outcomes	Teaching Strategies	Assessment Strategies
c1	Simulate the most algorithms and techniques of theory part using C++ language in Unix/Linux environment.	<ul style="list-style-type: none"> ▪ Project\presentation\seminar, ▪ Exercises and home works, ▪ Laboratory\Practical experiments based session, ▪ Computer laboratory-based sessions, ▪ Problem based learning, ▪ Team work (cooperative learning), ▪ Field visits. 	<ul style="list-style-type: none"> ▪ Lab\Project report ▪ Practical Lab performance assessment ▪ Coursework activities assessment, ▪ Home works and assignments.
c2	Build a mini shell and	<ul style="list-style-type: none"> ▪ Project\presentation\seminar, 	<ul style="list-style-type: none"> ▪ Lab\Project report

	custom kernel of operating system.	<ul style="list-style-type: none"> ▪ Exercises and home works, ▪ Laboratory\Practical experiments based session, ▪ Computer laboratory-based sessions, ▪ Problem based learning, ▪ Team work (cooperative learning), ▪ Field visits. 	<ul style="list-style-type: none"> ▪ Practical Lab performance assessment ▪ Coursework activities assessment, ▪ Home works and assignments.
(D) Alignment of Course Intended Learning Outcomes (Transferable Skills) to Teaching Strategies and Assessment Methods:			
	Course Intended Learning Outcomes	Teaching Strategies	Assessment Strategies
d1	Retrieve new information and knowledge effectively using all alternatives learning resource.	<ul style="list-style-type: none"> ▪ Project\presentation\seminar, ▪ Interactive class discussions, ▪ Exercises and home works, ▪ Laboratory\Practical experiments based session, ▪ Computer laboratory-based sessions, ▪ Directed self- study, ▪ Problem based learning, ▪ Team work (cooperative learning). 	<ul style="list-style-type: none"> ▪ Written tests (mid and final terms and quizzes), ▪ Short reports, ▪ Lab\Project report ▪ Practical Lab performance assessment ▪ Coursework activities assessment, ▪ Home works and assignments, ▪ Presentations.
d2	Self-learning dependency.	<ul style="list-style-type: none"> ▪ Project\presentation\seminar, ▪ Interactive class discussions, ▪ Exercises and home works, ▪ Laboratory\Practical experiments based session, ▪ Computer laboratory-based sessions, ▪ Directed self- study, ▪ Problem based learning, 	<ul style="list-style-type: none"> ▪ Written tests (mid and final terms and quizzes), ▪ Short reports, ▪ Lab\Project report ▪ Practical Lab performance assessment ▪ Coursework activities assessment, ▪ Home works and assignments,

		<ul style="list-style-type: none"> ▪ Team work (cooperative learning). 	<ul style="list-style-type: none"> ▪ Presentations.
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IV. Course Contents:				
A. Theoretical Aspect:				
No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
1	Introduction	<ul style="list-style-type: none"> – What is an Operating System? – Computer-System Organization – Computer-System Architecture – Operating-System Structure – Process Management – Memory Management – Storage Management – Protection and Security – Kernel Data Structures – Computing Environments – Open-Source Operating Systems 	2	4
2	Operating-System Structures	<ul style="list-style-type: none"> – Operating System Services – User Operating System Interface – System Calls – Types of System Calls – System Programs – Operating System Design and Implementation – Operating System Structure – Operating System Debugging – Operating System Generation – System Boot 	1	2
3	Processes	<ul style="list-style-type: none"> – Process Concept – Process Scheduling – Operations on Processes 	1	2

		<ul style="list-style-type: none"> – Inter-process Communication – Communication in Client-Server Systems 		
4	Threads & Concurrency	<ul style="list-style-type: none"> – Overview – Multicore Programming – Multithreading Models – Thread Libraries – Implicit Threading – Threading Issues – Operating System Examples 	1	2
5	CPU Scheduling	<ul style="list-style-type: none"> – Basic Concepts – Scheduling Criteria – Scheduling Algorithms – Thread Scheduling – Multiple-Processor Scheduling – Real-Time CPU Scheduling – Algorithm Evaluation 	2	2
6	Mid-Term Theoretical Exam		1	2
7	Main Memory	<ul style="list-style-type: none"> – Background – Swapping – Contiguous Memory Allocation – Segmentation – Paging – Structure of the Page Table 	1	2
8	Virtual Memory	<ul style="list-style-type: none"> – Background – Demand Paging – Copy-on-Write – Page Replacement – Allocation of Frames – Thrashing – Memory-Mapped Files – Allocating Kernel Memory – Operating-System Examples 	2	4

9	Mass-Storage Systems	<ul style="list-style-type: none"> - An overview - Disk Structure - Disk Attachment - Disk Scheduling - Disk Management - Swap-Space Management - RAID Structure 	1	2
10	I/O Systems	<ul style="list-style-type: none"> - Overview - I/O Hardware - Application I/O Interface - Kernel I/O Subsystem - Transforming I/O Requests to Hardware Operations - STREAMS Performance 	1	2
11	Synchronization	<ul style="list-style-type: none"> - The Critical-Section Problem - Peterson's Solution - Mutex Locks - Semaphores 	1	2
12	Deadlock	<ul style="list-style-type: none"> - Classic Problems of Synchronization - Deadlock in Multithreaded Applications - Methods for Handling Deadlocks - Deadlock Prevention - Deadlock Avoidance - Deadlock Detection - Recovery from Deadlock 	1	2
13	Final Theoretical Exam	-	1	2
Number of Weeks /and Units Per Semester			16	32

B. Practical Aspect:

No.	Tasks/ Experiments	Number of Weeks	Contact Hours
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B. Practical Aspect:			
1	Computer Lab (Unix/Linux)/C++: - Introduction to Unix/Linux - Installation and configuration Basic Unix/Linux commands	1	2
2	More Unix/Linux commands	2	2
3	- Shell Scripting Programming - Simulation of Unix/Linux commands	3	2
4	- Processes Creation	4	2
5	- Introduction to Threads Programming	5	2
6	- CPU Scheduling Algorithms Programming	6	2
7	- Mid-Term Practical Exam	7	2
8	- Unix/Linux file system and file security	8	2
9	Main Memory Management	9	2
10	- Virtual Memory Management	10	2
11	- Multi-Threaded/Multi-Cores Programming	11	2
12	- Mass-storage Scheduling Algorithms.	12	2
13	- Synchronization and Deadlock	13	2
14	Course Project: - Examples: Mini-shell, Custom Kernel, etc.	Starts from week 4	-
15	- Final Practical Exam Including Project presentation & Evaluation	15	2
Number of Weeks /and Units Per Semester		15	30

C. Tutorial Aspect:			
No.	Tutorial	Number of Weeks	Contact Hours
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
Number of Weeks /and Units Per Semester			

V. Teaching Strategies of the Course:
<ul style="list-style-type: none"> - Interactive lectures, - Interactive class discussions, - Directed self- study, - Tutorials, - Exercises and home works, - Problem based learning, - Laboratory\Practical experiments based session, - Computer laboratory-based sessions, - Team work (group learning), - Project\presentation\seminar.

VI. Assessment Methods of the Course:
<ul style="list-style-type: none"> - Written tests (mid and final terms and quizzes),

- Short reports,
- Coursework activities assessment,
- Home works and assignments,
- Lab\Project report,
- Practical Lab performance assessment,
- Presentations.

VII. Assignments:

No.	Assignments	Week Due	Mark
1	Assignment 1: (Operating-System concepts Structures, Processes, Threads & Concurrency, and CPU Scheduling)	6	5
2	Assignment 2: (Main Memory, Virtual Memory, Mass-Storage Systems, and Disk Scheduling)	10	5
3	Assignment 3: (Project report)	13	5
Total			15

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

No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment
1	Assignments	6, 10, 13	15	15%
2	Quizzes 1 & 2	6, 12	5	5%
3	Mid-Term Theoretical Exam	8	10	10%
4	Mid-Term Practical Exam	9	10	10%
5	Final Practical Exam including Project Presentation & Evaluation	15	10	10%
6	Final Theoretical Exam	16	50	50%
Total			100	100%

IX. Learning Resources:

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

Example:

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1- Required Textbook(s) (maximum two):

- 1- ABRAHAM SILBERSCHATZ, PETER BAER GALVIN, GREG GAGNE, 2018, Operating Systems concepts, 10th, USA, Wiley.
- 2- Andrew S. Tanenbaum, Herbert Bos, 2015, modern operating systems, 4th, USA, Pearson.
- 3- Yashavant P. Kanetkar ,2003, Unix Shell Programming,

2- Essential References:

- 1- William Stallings, 2018, Operating Systems Internals and Design Principles, 9th, USA, Pearson.
- 2- Richard Petersen, 2008, Linux: The Complete Reference, 6th, USA, McGraw-Hill.
- 3- Kenneth H. Rosen, Douglas A. Host, etc., 2007, UNIX-The Complete Reference, 2nd, USA, McGraw-Hill.
- 4- Paul Cobbaut, 2015, Linux Fundamentals, Netsec BVBA.

3- Electronic Materials and Web Sites etc.:

Websites:

- 1- <https://github.com/aut-ce/CE303-OS/find/master>.

2-

Journals:

3-

Other Web Sources:

XI. Course Policies: (Based on the Uniform Students' Bylaw (2007))

Class Attendance:

- | | |
|---|---|
| 1 | Class Attendance is mandatory. A student is considered absent and shall be banned from taking the final exam if his/her absence exceeds 25% of total classes. |
| 2 | Tardiness: |



	A student will be considered late if he/she is not in class after 10 minutes of the start time of class.
3	Exam Attendance/Punctuality: No student shall be allowed to the exam hall after 30 minutes of the start time, and shall not leave the hall before half of the exam time has passed.
4	Assignments & Projects: Assignments and projects must be submitted on time. Students who delay their assignments or projects shall lose the mark allocated for the same.
5	Cheating: Cheating is an act of fraud that results in the cancelation of the student's exam or assignment. If it takes place in a final exam, the penalties stipulated for in the Uniform Students' Bylaw (2007) shall apply.
6	Forgery and Impersonation: Forgery/Impersonation is an act of fraud that results in the cancelation of the student's exam, assignment or project. If it takes place in a final exam, the penalties stipulated for in the Uniform Students' Bylaw (2007) shall apply.
7	Other policies: The University official regulations in force will be strictly observed and students shall comply with all rules and regulations of the examination set by the Department, Faculty and University Administration.