I. COURSE INFORMATION

COURSE CODE	COMP4501
COURSE TITLE	Fundamentals of Operating Systems
OMAN QUALIFICATION FRAMEWORK (OQF) LEVEL	**7**
CREDIT HOURS	3
CONTACT HOURS	4
PRE-REQUISITES	COMP3203 AND COMP3501
CO-REQUISITES	-
EQUIVALENT COURSES	COMP5516
INCOMPATIBLE COURSES	-

COURSE CATEGORY		
	☐ University Requirement	☐ University Elective
	☐ College Requirement	☐ College Elective
	☐ Department Requirement	☐ Department Elective
	☒ Major Requirement	☐ Major Elective
	☐ Specialization Requirement	☐ Specialization Elective
	☐ Other (specify):	

COURSE OWNER		
	College: Science	Department: Computer Science
	Center:	Unit:

DELIVERY MODE	☒ Face to Face	☐ Blended	☐ Online

COURSE TYPE		
	☐ Lecture	☐ Lecture/Lab
	☐ Lecture/Seminar	☐ Lecture/Studio
	☒ Lecture/Tutorial	☐ Lecture/Lab/Tutorial or Seminar
	☐ Tutorial	☐ Laboratory (Practical)
	☐ Field or Work Placement	☐ Studio
	☐ Seminar	☐ Internship
	☐ Workshop	☐ Project
	☐ Thesis	☐ Other (specify):

LANGUAGE OF INSTRUCTION	English
COURSE DESCRIPTION	Study the fundamental operating systems concepts including, classification of operating systems, operating systems structures, processes, process synchronization, deadlock, CPU scheduling, memory management, I/O

	systems, and OS security. The course includes a practical project for implementing a prototype for a major component of an operating system. A modern operating system will be used for a case study	
TEACHING AND LEARNING STRATEGIES	☐ Augmented Reality	☐ Flipped Classroom
	☒ Blended Learning	☐ Problem-Based Learning
	☐ Discovery-Based Learning	☐ Project-Based Learning
	☐ Student-Led Learning	☐ Team-Based Learning
	☐ Work-Based Learning	☐ Other (specify):

ASSESSMENT COMPONENT AND WEIGHT	☒In-term examination(s) (20%)	☒ Quizzes (10 %)	☐Other (specify): (%)
	☒ Homework assignments (20%)	☒Project (10%)	
	☒ Final examination (40%)	☐ Practical/ Lab (%)	

TEXTBOOKS AND EDUCATIONAL MATERIAL	"Operating System Concepts" by Silberschatz, 10th Ed, John Wiley, 2018		
GRADING METHOD	☒ A-F Scale	☐ Pass/Not Pass	☐ Other (specify):

GRADING METHOD DESCRIPTION

A-F GRADING SCALE:	Range	Letter Grade	Description
	90 – 100	A	**Exceptional performance:** All course objectives achieved and met in a consistently outstanding manner.
	86 – 89.9	A-	
	81– 85.9	B+	**Very Good Performance:** The majority of the course objectives achieved (majority being at least two-thirds) and met in a consistently thorough manner.
	77 – 80.9	B	
	73 – 76.9	B-	
	68 – 72.9	C+	**Satisfactory Performance:** At least most of course objectives have been achieved and met satisfactorily.
	64 – 67.9	C	
	60 – 63.9	C-	
	55 – 59.9	D+	**Minimally Acceptable Performance:** The course objectives met at a minimally acceptable level.
	50 – 54.9	D	
	0 – 49.9	F	**Unacceptable performance:** The course objectives not met at a minimally acceptable level.

PASS/NOT PASS:	
OTHER:	

II. SEMESTER INFORMATION			
SEMESTER/YEAR	Spring/2025	**SECTION(S)**	1
DAY AND TIME	MON (12:00 - 13:50) WED (12:00 - 13:50)	**VENUE(S)**	SCI/0018, D06
COURSE COORDINATOR	Dr. Haleh Amintoosi	**COURSE TEAM**	-
COORDINATOR OFFICE	2230	**OFFICE HOURS**	MON(10:00-12:00)

			WED(10:00 -12:00)
COORDINATOR EXTENSION	2227	**COORDINATOR EMAIL**	h.amintoosi@squ.edu.om

III. ALIGNMENT OF COURSE LEARNING OUTCOMES (CLO), PROGRAM LEARNING OUTCOMES (PLO), GRADUATE ATTRIBUTES (GA), AND OMAN QUALIFICATION FRAMEWORK (OQF) CHARACTERISTICS			
CLO	**PLO / SO**	Error! Reference source not found.	Error! Reference source not found.
1. Describe the role and structure of modern operating system.	**SO1**	**A**	**1**
2. Write computer programs for creating and manipulating processes and threads.	**SO1,SO2**	**A**	**1,2**
3. Understand the common algorithms used for task scheduling by the operating system.	**SO2, SO3**	**A,B,C**	**1,2,3,6**
4. Solve process synchronization problems using various process synchronization tools such as semaphores and monitors.	**SO2, SO3**	**A,B,C**	**1,2,3**
5. Implement basic deadlock detection, avoidance and prevention techniques.	**SO1, SO2, SO3**	**A,B,C**	**1,2,3**
6. Understand the various memory allocation and management techniques and algorithms.	**SO1**	**A**	**1**
7. Understand file structures and management techniques.	**SO1**	**A**	**1**
8. Understand the concept of virtualization and solve the related problems.	**SO3, SO4**	**A,B,C,D**	**1,2,3,6**
9. Work in a team on a predefined topic related to the course.	**SO5, SO6**	**D,E,F**	**4,5**
10. Read a specific topic related the course, write a technical report and present findings.	**SO3, SO4**	**B,C,D,E**	**2,3,6**

IV. COURSE LEARNING OUTCOMES (CLOS) AND ASSESSMENT CRITERIA AND METHODS (FOR EACH CLO)	
CLO1: DESCRIBE THE ROLE AND STRUCTURE OF MODERN OPERATING SYSTEM.	
ASSESSMENT CRITERIA (TO ACHIEVE THIS OBJECTIVE, THE STUDENT MUST)	**ASSESSMENT METHODS**
A) Describe the general organization of a computer system	
B) Illustrate the transition from user mode to kernel mode	Assignment #1, Final exam, Mid-Exam
C) Illustrate how system calls are used to provide operating system services	
D) Describe multitasking, multiprogramming and multicoring	
E) Describe the components in a modern, multiprocessor computer system	
F) Compare and contrast monolithic, layered, microkernel, modular,	

	and hybrid strategies for designing operating systems	
E)	Illustrate the process for booting an operating system	

CLO2: WRITE COMPUTER PROGRAMS FOR CREATING AND MANIPULATING PROCESSES AND THREADS.		
ASSESSMENT CRITERIA (TO ACHIEVE THIS OBJECTIVE, THE STUDENT MUST)		**ASSESSMENT METHODS**
A)	Describe the benefits and challenges of designing multithreaded applications	Final Exam, Mid-Exam
B)	Identify the basic components of a thread and contrast threads and processes	
C)	Illustrate different approaches to implicit threading, including thread pools, fork-join, and Grand Central Dispatch.	
D)	Describe how the Windows and Linux operating systems represent threads	

CLO3: UNDERSTAND THE COMMON ALGORITHMS USED FOR TASK SCHEDULING BY THE OPERATING SYSTEM.		
ASSESSMENT CRITERIA (TO ACHIEVE THIS OBJECTIVE, THE STUDENT MUST)		**ASSESSMENT METHODS**
A)	Explain the issues related to multiprocessor and multicore scheduling	Assignment#2, Final Exam, Mid-exam
B)	Describe various CPU scheduling algorithms	
C)	Assess CPU scheduling algorithms based on scheduling criteria	
D)	Describe various real-time scheduling algorithms	

CLO4: SOLVE PROCESS SYNCHRONIZATION PROBLEMS USING VARIOUS PROCESS SYNCHRONIZATION TOOLS SUCH AS SEMAPHORES AND MONITORS.		
ASSESSMENT CRITERIA (TO ACHIEVE THIS OBJECTIVE, THE STUDENT MUST)		**ASSESSMENT METHODS**
A)	Identify the separate components of a process and illustrate how they are represented and scheduled in an operating system	Quiz#1, Final Exam, Mid-exam, Project
B)	Describe how processes are created and terminated in an operating system, including developing programs using the appropriate system calls that perform these operations	
C)	Describe and contrast interprocess communication using shared memory and message passing.	
D)	Demonstrate how mutex locks, semaphores, monitors, and condition variables can be used to solve the critical section problem	

CLO5: IMPLEMENT BASIC DEADLOCK DETECTION, AVOIDANCE AND PREVENTION TECHNIQUES.		
ASSESSMENT CRITERIA (TO ACHIEVE THIS OBJECTIVE, THE STUDENT MUST)		**ASSESSMENT METHODS**
A)	Illustrate how deadlock can occur when mutex locks are used	Final Exam, Assignment#3
B)	Define the four necessary conditions that characterize deadlock	
C)	Identify a deadlock situation in a resource allocation graph	
D)	Evaluate the four different approaches for preventing deadlocks	
E)	Apply the banker's algorithm for deadlock avoidance	
F)	Apply the deadlock detection algorithm	

G)	Evaluate approaches for recovering from deadlock	

CLO6: UNDERSTAND THE VARIOUS MEMORY ALLOCATION AND MANAGEMENT TECHNIQUES AND ALGORITHMS.		
ASSESSMENT CRITERIA (TO ACHIEVE THIS OBJECTIVE, THE STUDENT MUST)		**ASSESSMENT METHODS**
A)	To provide a detailed description of various ways of organizing memory hardware	Quiz #2, Final Exam
B)	To discuss various memory-management techniques,	
C)	Define virtual memory and describe its benefits.	
D)	Illustrate how pages are loaded into memory using demand paging.	
E)	Apply the FIFO, optimal, and LRU page-replacement algorithms	

CLO7: UNDERSTAND FILE STRUCTURES AND MANAGEMENT TECHNIQUES.		
ASSESSMENT CRITERIA (TO ACHIEVE THIS OBJECTIVE, THE STUDENT MUST)		**ASSESSMENT METHODS**
A)	To explain the function of file systems	Final Exam
B)	To describe the interfaces to file systems	
C)	To discuss file-system design tradeoffs, including access methods, file sharing, file locking, and directory structures	
D)	Describe the details of implementing local file systems and directory structures.	
E)	Discuss block allocation and free-block algorithms and trade-offs	
B)	Explain the fundamentals of encryption, authentication, and hashing	

CLO8: WORK IN A TEAM ON A PREDEFINED TOPIC RELATED TO THE COURSE.		
ASSESSMENT CRITERIA (TO ACHIEVE THIS OBJECTIVE, THE STUDENT MUST)		**ASSESSMENT METHODS**
A)	Work in a team on a predefined topic related to the course	Project

CLO9: READ A SPECIFIC TOPIC RELATED THE COURSE, WRITE A TECHNICAL REPORT AND PRESENT FINDINGS.		
ASSESSMENT CRITERIA (TO ACHIEVE THIS OBJECTIVE, THE STUDENT MUST)		**ASSESSMENT METHODS**
A)	Read a specific topic related to the course, write a technical report and present findings.	Project

V. Course Content and Schedule

Week	Lectures #	Topics/ Subjects	Readings/ Chapters	Remarks (e.g., Assessments)
1	1st class	Introduction	ch1	Final Exam, Assignemnt#1
	2nd class	What Operating Systems Do, Computer-System Organization, Computer-System Architecture, Operating-System Operations, Resource Management, Interrupts	ch1	Final Exam, Assignemnt#1, Mid-Exam
2	1st class	Storage Management, Multiprogramming and Multitasking, Process Management, Memory Management, Caching, Computer System Environments	ch1	Final Exam, Mid-Exam Assignemnt#1
	2nd class	Process Concept, Process Scheduling, Operations on Processes,	ch3	Final Exam, Mid-Exam Assignemnt#1
3	1st class	Inter Process Communication (IPC), Producer Consumer problem	ch3	Final Exam, Quize#1
	2nd class	IPC in Shared-Memory Systems, IPC in Message-Passing Systems, Examples of IPC Systems	ch3	Final Exam, Quize#1
4	1st class	Multicore Programming, Multithreading Models, Thread Libraries	ch4	Final Exam, Mid-Exam,
	2nd class	Implicit Threading, Threading Issues, Operating System Examples	ch4	Final Exam, Mid-Exam,
5	1st class	Basic Concepts, Scheduling Criteria, Scheduling Algorithms, Thread Scheduling	ch5	Final Exam, Mid-Exam, Assignemnt#2
	2nd class	Multi-Processor Scheduling, Algorithm Evaluation	ch5	Final Exam, Mid-Exam,
6	1st class	Ch4+Ch5	tutorial	
	2nd class	The Critical-Section Problem, Peterson's Solution, Hardware Support for Synchronization	ch6	Final Exam, Mid-Exam,
7	1st class	Semaphores and Monitors, Liveness and Evaluation	ch6	Final Exam, Mid-Exam, Assignemnt#2
	2nd class	Ch6	tutorial	
8	1st class	Synchronization, Bounded buffer problem	ch7	Final Exam,
9	2nd class	Readers and Writers Problem, Dining Philosophers problem	ch7	Final Exam, Project
10	1st class	System Model, Deadlock Characterization, Methods for Handling Deadlocks	ch8	Final Exam, Quize#2, Assignemnt#3
	2nd class	Deadlock Prevention, Deadlock Avoidance,	ch8	Final Exam, Quize#2, Assignemnt#3
11	1st class	Deadlock Detection, Recovery from Deadlock	ch8	Final Exam, Quize#2, Assignemnt#3, Project
	2nd class	Contiguous Memory Allocation, Paging,	ch9	Final Exam, Quize#2
12	1st class	Structure of the Page Table, Swapping,	ch9	Final Exam, Quize#2

	2nd class	Demand Paging, Copy-on-Write, Page Replacement,	ch10	Final Exam, Quize#2
13	1st class	Ch8+ch9	tutorial	
	2nd class	File Concept, Access Methods	ch13	Final Exam
14	1st class	Disk and Directory Structure,	ch13	Final Exam
	2nd class	File Sharing, Protection	ch13	Final Exam,
15	1nd class	ch10	tutorial	
	2nd class	ch13	tutorial	

VI. ADDITIONAL INFORMATION (e.g., RUBRICS, etc.)

ASSIGNMENTS (20 MARKS), QUIZ#1 (5 MARKS), QUIZ#2 (5 MARKS), PROJECT (10 MARKS), MID (20 MARKS), FINAL (40 MARKS)

ASSESSMENT COMPONENT	POSTED DATE	DUE DATE	WEIGHT
ASSIGNEMNT#1	WEEK2	WEEK3	5%
QUIZ#1	WEEK 4		5 %
ASSIGNEMNT#2	WEEK7	WEEK9	10%
MID-EXAM	WEEK8		20%
PROJECT	WEEK9	WEEK13	10%
QUIZ#2	WEEK12		5%
ASSIGNEMNT#3	WEEK 13	WEEK14	5%
FINAL EXAM	WEEK16: 25/05/2025, 11: 30-14:30		40%

Department's Late Submission Policy:

(a) 1-24 hours: 25% of the mark will be deducted.
(b) > 24 hours: Not accepted.

Department's Policy for Dealing with Cheating:

It is essential that each student solves all programming assignments, lab tests and exams individually unless instructed otherwise, e.g., for group projects. Copying, plagiarism, collusion, switching, and falsification are violations of the university academic regulations. Students involved in such acts will be severely penalized. The department has adopted a firm policy on this issue. A zero mark will be assigned the first time a student is caught involved in copying and his/her name will be added to a watch list maintained by the Head of Department. Further repeated involvements in copying will cause the student to get an F grade in that course. This is in line with the university academic regulations.

VII. STUDENTS RESPONSIBILITIES

It is the student's responsibility to know and comply with all University Academic Regulations relevant to participation in this course. These regulations specifically include attendance requirements and student academic code of conduct.

ACADEMIC INTEGRITY	The University expects the students to approach their academic endeavors with the highest academic integrity. Please refer to the **Undergraduate Academic Regulations**.
ADD AND DROP	Students who wish to drop or add the course should review the **Undergraduate Academic Regulations**.
ATTENDANCE	Sultan Qaboos University has a clear requirement for students to attend courses, detailed in the **Undergraduate Academic Regulations**.
ASSESSMENT AND GRADING	To ensure the provision of a sound and fair assessment and grading, please review the **Undergraduate Academic Regulations**.
GRADE APPEAL	Students who wish to appeal their grades should review the **Undergraduate Academic Regulations**.
CLASSROOM POLICIES	Students are expected to dress professionally during class time as required by the University. Use of phones or any other electronic devices in the classroom during class time is strictly prohibited. Unauthorized use may lead to faculty member confiscation of the device for the remainder of the class. Behavior that persistently or grossly interferes with classroom activities is considered disruptive behavior and may be subject to disciplinary action. A student responsible for disruptive behavior may be required to leave the class.
LATE AND MAKE-UP WORK	Students are required to meet the course objectives by submitting coursework no later than the assigned due date. Students may be allowed to submit late work if approved by the course coordinator. Assignments submitted after the due date may be penalized.
MISSED EVALUATIONS	All quizzes, tests, clinical evaluations, and exams must be completed by the date they are assigned. If a quiz, test, or exam is missed due to a documented emergency situation (e.g., medical emergency, death in the immediate family), it is the student's responsibility to contact the instructor.
OTHER	

Course Outline Appendix

A. **PROGRAM LEARNING OUTCOMES**

SO1. Analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions.

SO2. Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline.

SO3. Communicate effectively in a variety of professional contexts.

SO4. Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles.

SO5. Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline.

SO6. Apply computer science theory and software development fundamentals to produce computing-based solutions

B. SQU Graduate Attributes and Competencies for Undergraduate Studies

GRADUATE ATTRIBUTES	GRADUATE COMPETENCIES FOR UNDERGRADUATE STUDIES
A. Cognitive Capabilities: The graduate has sufficient general and specialized theoretical knowledge that enables him/her to deal well with his/her specialty and other related fields.	1. Demonstrates familiarity and works with advanced specialized knowledge in the area of specialization.
	2. Demonstrates a general understanding of the relationship of advanced specialized knowledge with knowledge in other relevant professional fields and aspects.
	3. Demonstrates a comprehensive understanding of the theories, principles, and methods used in his/her specialty, and how to create and apply new knowledge.
	4. Demonstrates general knowledge of the legal environment and necessary relevant regulatory frameworks.
	5. Shows awareness of contemporary literature and research.
B. Skill and Professional Capability: The graduate has sufficient skill and practical experience that enables him/her to perform all tasks related to the specialization and other related fields.	1. Applies concepts, theories, and investigative methods to synthesize and interpret information to evaluate conclusions.
	2. Applies appropriate research methods and techniques and employs digital knowledge
	3. Evaluates and critiques information independently
	4. Uses cognitive and technical skills to analyze

	complex issues and develop appropriate solutions.
	5. Initiates new ideas or processes in the professional, educational or research context.
C. Effective Communication: The graduate has the ability to communicate effectively with others to achieve the desired results	1. Explains, presents, and adapts information to suit the recipients.
	2. Employs appropriate information and communication technology to collect and analyze information.
D. Autonomy and Leadership: The graduate has the ability to lead, make decisions and take responsibility for decisions.	1. Performs advanced professional activities independently.
	2. Demonstrates leadership skills.
	3. Takes professional responsibility.
	4. Assumes full accountability for the tasks and their output.
E. Responsibility and Commitment: The graduate appreciates the importance of available resources and deals with them effectively and is committed to the ethics of the profession and society.	1. Manages time and other resources assigned to accomplishing tasks effectively and responsibly.
	2. Demonstrates effective practices when working in teams.
	3. Demonstrates advanced levels of understanding of values and ethics relevant to the specialization, profession and local and international society and promotes them among others.
	4. Works within the professional, institutional, and specialization guiding frameworks and strategic plans.
	5. Interacts with community affairs positively and preserves national identity.
	1. Demonstrates the ability to independently manage learning tasks, with an awareness of how to

F. Development and Innovation: The graduate has a passion for development and innovation in the field of specialization.	develop and apply new knowledge.
	2. Utilizes specialized knowledge and skills for entrepreneurship.
	3. Utilizes creative and innovative skills in the field of specialization.

C. **OQF Characteristics**
1. Knowledge
2. Skills
3. Communication, Numeracy, and Information and Communication Technology Skills.
4. Autonomy and Responsibility
5. Employability and Values
6. Learning to learn