Course Specification of Operating System Concepts

Course No (.....)

2020/2021

Head of Department	Vise Dean for Quality Assurance	Dean of the Faculty	Dean of Academic Development center and Quality
Dr. Ahmed Al-shalabi	Dr. Anwar Al-Shamiri	Dr. Nagi Al-Shibani	Assoc. Prof. Dr.Huda Al.Emad

Rector of Sana'a University

Prof. Dr. Qassim Mohammed Abbas

I. Course Identification and General Information:

1	**Course Title:**	Operating System Concepts				
2	**Course Code & Number:**					
3	**Credit hours:**	C.H				TOTAL
		Th.	Seminar	Pr	Tr.	
		2		**2**		**3**
4	**Study level/ semester at which this course is offered:**	2nd Level -2nd Semester				
5	**Pre –requisite (if any):**	Computer Architecture and Organization, Programming fundamentals				
6	**Co –requisite (if any):**	None				
7	**Program (s) in which the course is offered:**	Computer Science, Information Technology, Information Systems				
8	**Language of teaching the course:**	Arabic/English				
9	**Study System**	Term based System				
10	**Mode of delivery:**	Full Time				
11	**Location of teaching the course:**	Faculty of Computer and Information Technology				
12	**Prepared By:**	Dr. Anwar Al-Shamiri				
13	**Date of Approval**					

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II. Course Description:

This course is an examination of the evolution of operating systems and design, focusing on hardware/software evolution leading to contemporary operating systems. It covers basic operating systems concepts, methods of operating systems design and construction, algorithms for CPU scheduling, memory and general resource allocation; process coordination and management. More attention is given to the application and operation of the existing operating system.

III. Course Intended learning outcomes (CILOs) of the course		Referenced PILOs
a.1	Demonstrate understanding of the main operating systems functions such as process management, memory management, and file and disk manage, security and protection.	A1
a.2	Identify the various components of a computer system and how they managed by the operating system.	
b1	Explore the operating systems functions such as process dispatching and scheduling algorithms, memory management methods and memory allocation, deallocation, page replacement algorithms, file system structures, and disk scheduling.	B1
b2	Evaluate different mechanisms of process scheduling, synchronization, memory allocation, disk allocation, file management, and protection.	
c1	Implement via simulation programs most common issues in OS such as PCB and scheduling algorithms, concurrency execution problems, real and virtual memory management methods, file allocation and disk algorithms.	C1,C3
c2	Operate operating systems, software, and computing equipment effectively.	
d1	Present technical ideas and operating system solutions based on the acquired knowledge.	D1,D3
d2	Work effectively independently and in team.	

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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. Demonstrate understanding of the main operating systems functions such as process management, memory management, and file and disk manage.	Lectures and Lab, Homework, and self-learning	Homework and Lab reports, Written exams , assignments.
a2. Identify the various components of a computer system and how they managed by the operating system.	Lectures and Lab, Homework, assignments.	Homework and Lab reports, Written exams , assignments.

(B) Alignment Course Intended Learning Outcomes of Intellectual Skills to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
b1. Explore the operating systems functions such as process dispatching and scheduling algorithms, memory management methods and memory allocation, deallocation, page replacement algorithms, file system structures, and disk scheduling.	Lectures and Lab, Homework, assignments.	Homework and Lab reports, Written exams , assignments.
b2. Evaluate different mechanisms of process scheduling, synchronization, memory allocation, disk allocation, and file management	Lectures, Lab, Homework, assignments.	Homework and Lab reports, Written exams , assignments.

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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. Implement via simulation programs most common issues in OS such as PCB and scheduling algorithms, concurrency execution problems, real and virtual memory management methods, file allocation and disk algorithms.	Lectures ,Lab, Homework, assignments.	Homework and Lab reports, Written exams , assignments.
c2. Operate operating systems, software, and computing equipment effectively.	Lectures ,Lab, Homework, assignments.	Homework and Lab reports, Written exams , assignments.

(D) Alignment Course Intended Learning Outcomes of Transferable Skills to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
d1. Present technical ideas and operating system solutions based on the acquired knowledge.	Reports, assignments	presentations ,Lab reports, assignments
d2. Work effectively independently and in team.	Projects and assignments	Homework , Lab reports, presentations

IV. Course Content:

A – Theoretical Aspect:

Order	Topic List / Units	Learning Outcomes	Sub Topics List	Number of Weeks	contact hours

1	**Introduction**	a1, a2, b1, b1, c1, c2, d2	OS history and evolution; role, purpose, goals, and services of OS; the functionality of a typical OS; OS design issues including efficiency, robustness, flexibility, portability, security, compatibility, API interfaces, device organization.	1	2
2	**OS Structure**	a1, b1, b2, b1, c1, c2, d1	Abstractions, Layered OS; Execution Mode: kernel and user modes, and mode transitions; OS events: external interrupts, traps, and system calls; interrupt handling.	1	2
3	**Process and Thread**	a1,a2, b1, b2, c1, c2, d2	Process concept; process attributes; PCB; Process states and state diagrams; Process queues and process table; dispatching and context switching; Process Scheduling: short-term (dispatcher), medium-term, and long-term schedulers; process creation and termination; child processes; process implementation issues; • Resources and device organization (device queues and device tables) • Uniprocessor scheduling algorithms: FCFS, Round Robin, SRJ and SRJF, Priority Scheduling, Multi-level Queues Scheduling, Comparison;	3	6
4	**Process Cooperation and Synchronizatio n**	a1,b2, c1, c2, d1, d2	Introduction to cooperating processes; critical-section problem and mutual exclusion; synchronization hardware; semaphores;	1	2
5	**Deadlocks**	a1,a2, b2, c1, c2, d1	Resource contention; deadlock conditions; deadlock detection; deadlock avoidance; deadlock	1	2

			prevention; deadlock implementation; Banker algorithm.		
7	**Memory Management**	a1, b2, b1, b2, c1, c2, d1, d2	Real Memory including: Program loading concept: object module and load module (compile-time, load-time, and run-time); fixed partitions and dynamic partitions; dynamic linking and overlays; allocation management (bitmap and linked list); logical address and physical address; MMU; memory management requirements: Protection, relocation sharing, address translation physical and logical organization; placement algorithms (Best-fit, First-fit, Next-fit, and Worst-fit).	1	2
8	**Memory Management (Virtual memory)**	a1, b2, b1, b2, c1, c2, d1, d2	Virtual Memory including: Demand paging (page mapping, page table, TLB); page replacement algorithms.	1	2
9	**Input/output and Mass-Storage Management**	a1, a2, b2, b2, c1, d1, d2	Device Controllers; Memory-Mapped I/O; Direct Memory Access; Interrupt Handlers; Device Drivers. Disk Structure; Disk Scheduling; Disk Management; RAID Structure	2	4
10	**File System Management**	a1, b2, c1, c2,d1	File Concept and Access Methods; Directory Structure; File System Mounting; Sharing and Protection; File System Structure; File System Implementation; Directory Implementation; Allocation Methods; Free-Space Management; Recovery; Log-Structured File Systems.	2	4

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11	**Security and Protection**	a1, b1, b2, b1, c1, c2, d1, d2	Interprocsess communication protection, user authentication, resources protection, file system security, access control, security vs. protection, security assurance.	1	2
Number of Weeks /and Units Per Semester				**14**	**28**

B - Practical Aspect: (if any)

Order	Tasks/ Experiments	CILOs (symbols)	Number of Weeks	Contact Hours
1	**Installing and configuring Linux OS**	a1,c2,d1	**2**	**4**
2	Linux shell commands	a1,c2,d1	**3**	**6**
3	Thread implementation using Linux Library	a1, c1, d1, d2	**1**	**2**
5	Scheduling algorithms implementation using C/C++ or Java.	a1, c1, d1, d2	**2**	**4**
6	Deadlock Banker Algorithm implementation using C/C++ or Java.	a1, c1, d1, d2	**1**	**2**
7	Virtual memory replacement algorithms implementation using data structures and C/C++ or Java.	a1, c1, d1, d2	**2**	**4**
8	FAT implementation using data structures and C/C++ or Java.	a1, c1, d1, d2	**1**	**2**
9	Disk scheduling implementation using data structures and C/C++ or Java.	a1, c1, d1, d2	**2**	**4**
Number of Weeks /and Units Per Semester			**14**	**28**

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V. Teaching strategies of the course:

- Lectures,
- Homework
- Classroom and Laboratory assignments
- Classroom discussion of a real problems (Brainstorming)
- Individual assignments.
- Laboratory practice
- Problems Solving

VI. Assignments:

No	Assignments	Aligned CILOs(symbols)	Week Due	Mark
1	Implementing Scheduling algorithms (FIFO, SJF,SRTF,RR)	a1, c1, d1, d2	8th	5
2	Implementing dining philosopher's problem solving.	a1, c1, d1, d2	13th	5
Total				10

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

No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment	Learning Outcomes
1	Assignments (single/group)	8th , 13th	10	10%	**ALL**
2	Mid-term Exam (theoretical)	8th	10	10%	ALL
3	Final Exam (theoretical)	16th	60	60%	ALL

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4	Final Exam (practical)	16th	20	20%	**c1, c2, c3**
Total			**100**	**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. Silberschatz, Galvin, Gagne, (2018), *Operating System Concepts*, 10th edition, USA, Wiley Publisher.

2- Essential References.

1. William Stallings (2014), *Operating Systems: Internals and design principles*, 8th edition, USA, Pearson Publisher..

3- Electronic Materials and Web Sites *etc.*

1. *http//u.cs.biu.ac.il/~ariel/download/os288/ppts – Good PowerPoint Slides in OS*
2. www.wiley.com/college/**silberschatz**6e/0471417432/**slides**/**slides**.html.

IX. Course Policies:

Unless otherwise stated, the normal course administration policies and rules of the Faculty of Computer and Information Technology apply. For the policy, see: ----------

The University Regulations on academic misconduct will be strictly enforced. Please refer to ----------

1	**Class Attendance:** A student should attend not less than 75 % of total hours of the subject; otherwise he will not be able to take the exam and will be considered as exam failure. If the student is absent due to illness, he/she should bring a proof statement from university Clinic
2	**Tardy:** For late in attending the class, the student will be initially notified. If he repeated lateness in attending class, he will be considered as absent.
3	**Exam Attendance/Punctuality:**

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	A student should attend the exam on time. He is Permitted to attend an exam half one hour from exam beginning, after that he/she will not be permitted to take the exam and he/she will be considered as absent in exam.
4	**Assignments & Project** The assignment is given to the students after each chapter; the student has to submit all the assignments for checking on time.
5	**Cheating:** For cheating in exam, a student will be considered as fail. In case the cheating is repeated three times during his/her study the student will be disengaged from the Faculty.
6	**Plagiarism:** Plagiarism is the attending of a student the exam of a course instead of another student. If the examination committee proofed a plagiarism of a student, he will be disengaged from the Faculty. The final disengagement of the student from the Faculty should be confirmed from the Student Council Affair of the university.
7	**Other policies:** - Mobile phones are not allowed to use during a class lecture. It must be closed, otherwise the student will be asked to leave the lecture room - Mobile phones are not allowed in class during the examination. - Lecture notes and assignments my given directly to students using soft or hard copy

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Faculty of Computer & Information Technology

Department of Computer Science

Program of Computer Science

Course syllabus of Operating System Concepts

Course No (.....)

2020/2021

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

II. Course Identification and General Information:						
1-	Course Title:	Operating System Concepts				
2-	Course Number & Code:					
3-	Credit hours:	C.H				Total
		Th.	Seminar	Pr.	F. Tr.	
		2		2		3
4-	Study level/year at which this course is offered:	*2nd semester -2nd year*				
5-	Pre –requisite (if any):	Computer Architecture and Organization, Programming fundamentals				
6-	Co –requisite (if any):	None				
7-	Program (s) in which the course is offered	Information Technology				
8-	Language of teaching the course:	Arabic/English				
9-	System of Study:	Term based system				
10-	Mode of delivery:	Full-time				
11-	Location of teaching the course:	Faculty of Computer and Information Technology				

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III. Course Description:

This course is an examination of the evolution of operating systems and design, focusing on hardware/software evolution leading to contemporary operating systems. It covers basic operating systems concepts, methods of operating systems design and construction, algorithms for CPU scheduling, memory and general resource allocation; process coordination and management. More attention is given to the application and operation of the existing operating system.

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

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

1. Demonstrate understanding of the main operating systems functions such as process management, memory management, and file and disk manage, security and protection.
2. Identify the various components of a computer system and how they managed by the operating system.
3. Explore the operating systems functions such as process dispatching and scheduling algorithms, memory management methods and memory allocation, deallocation, page replacement algorithms, file system structures, and disk scheduling.
4. Evaluate different mechanisms of process scheduling, synchronization, memory allocation, disk allocation, file management, and protection.
5. Implement via simulation programs most common issues in OS such as PCB and scheduling algorithms, concurrency execution problems, real and virtual memory management methods, file allocation and disk algorithms.
6. Operate operating systems, software, and computing equipment effectively.
7. Present technical ideas and operating system solutions based on the acquired knowledge.
8. Work effectively independently and in team.

V. Course Content:

- Distribution of Semester Weekly Plan of Course Topics/Items and Activities

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A – Theoretical Aspect:				
Order	**Topic List / Units**	**Sub Topics List**	**Week Due**	**Contact Hours**
1	**Introduction**	OS history and evolution; role, purpose, goals, and services of OS; the functionality of a typical OS; OS design issues including efficiency, robustness, flexibility, portability, security, compatibility, API interfaces, device organization.	1st	2
2	**OS Structure**	Abstractions, Layered OS; Execution Mode: kernel and user modes, and mode transitions; OS events: external interrupts, traps, and system calls; interrupt handling.	2nd	2
3	**Process and Thread**	Process concept; process attributes; PCB; Process states and state diagrams; Process queues and process table; dispatching and context switching; Process Scheduling: short-term (dispatcher), medium-term, and long-term schedulers; process creation and termination; child processes; process implementation issues; • Resources and device organization (device queues and device tables) • Uniprocessor scheduling algorithms: FCFS, Round Robin, SRJ and SRJF, Priority Scheduling, Multi-level Queues Scheduling, Comparison;	5th	6
4	**Process Cooperation and Synchronization**	Introduction to cooperating processes; critical-section problem and mutual exclusion; synchronization hardware; semaphores;	6th	2
5	**Deadlocks**	Resource contention; deadlock conditions; deadlock detection; deadlock avoidance;	7th	2

		deadlock prevention; deadlock implementation; Banker algorithm.		
6	**Mid Term Exam**	Mid-term exam	8th	2
7	**Memory Management**	Real Memory including: Program loading concept: object module and load module (compile-time, load-time, and run-time); fixed partitions and dynamic partitions; dynamic linking and overlays; allocation management (bitmap and linked list); logical address and physical address; MMU; memory management requirements: Protection, relocation sharing, address translation physical and logical organization; placement algorithms (Best-fit, First-fit, Next-fit, and Worst-fit).	11th	6
8	**Input/Output and Mass-Storage Management**	Virtual Memory including: Demand paging (page mapping, page table, TLB); page replacement algorithms.	12th	2
9	**File System Management**	Device Controllers; Memory-Mapped I/O; Direct Memory Access; Interrupt Handlers; Device Drivers. Disk Structure; Disk Scheduling; Disk Management; RAID Structure	13th	2
10	**Networking/Distributed Systems**	File Concept and Access Methods; Directory Structure; File System Mounting; Sharing and Protection; File System Structure; File System Implementation; Directory Implementation; Allocation Methods; Free-Space Management; Recovery; Log-Structured File Systems.	14th	2
11	**Security and Protection**	Interprocsess communication protection, user authentication, resources protection,	15th	2

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		file system security, access control, security vs. protection, security assurance.		
12	**Final Exam**	Final Exam	16th	2
Number of Weeks /and Units Per Semester			**16**	**32**

B - Practical Aspect:

Order	Topics List (Tasks/ Experiments)	Week Due	Contact Hours
1	**Installing and configuring Linux OS**	**2nd**	**4**
2	Linux shell commands	**5th**	**6**
3	Thread implementation using Linux Library	**6th**	**2**
4	Mid Term Exam	**7th**	**2**
5	Scheduling algorithms implementation using C/C++ or Java.	**9th**	**4**
6	Deadlock Banker Algorithm implementation using C/C++ or Java.	**10th**	**2**
7	Virtual memory replacement algorithms implementation using data structures and C/C++ or Java.	**12th**	**4**
8	FAT implementation using data structures and C/C++ or Java.	**13th**	**2**
9	Disk scheduling implementation using data structures and C/C++ or Java.	**15th**	**4**
10	**Final Exam**	**16th**	**2**

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Number of Weeks /and Units Per Semester	16	32

VI. Teaching strategies of the course:

- Lectures,
- Homework
- Classroom and Laboratory assignments
- Classroom discussion of a real problems (Brainstorming)
- Individual assignments.
- Laboratory practice
- Problems Solving

VII. Assignments:

No	Assignments	Week Due	Mark
1	Implementing Scheduling algorithms (FIFO, SJF,SRTF,RR)	8th	5
2	Implementing dining philosopher's problem solving.	13th	5
	Total		10

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

Assessment	Type of Assessment Tasks	Week Due	Mark	Proportion of Final Assessment
1	Assignments (single/group)	8th, 13th	10	10%

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2	Mid-term Exam (theoretical)	8th	10	10%
3	Final Exam (theoretical)	16th	60	60%
4	Final Exam (practical)	16th	20	20%
Total			100	100%

IX. Learning Resources:

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1. William Stallings (2014), *Operating Systems: Internals and design principles*, 8th edition, USA, Pearson Publisher..

3- Electronic Materials and Web Sites *etc.*

3. *http//u.cs.biu.ac.il/~ariel/download/os288/ppts – Good PowerPoint Slides in OS*
1. www.wiley.com/college/**silberschatz**6e/0471417432/**slides**/**slides**.html.

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اللجنة الإشرافية			
م.	الاســـم	الصـــــفة	التوقيع
١	أ.م.د. عبد الماجد الخليدي	نائب عميد الكلية للشؤون الأكاديمية	
٢	أ.م.د. احمد مجاهد	نائب عميد مركز التطوير الأكاديمي وضمان الجودة	
٣	د. حسين الأشول	ممثل المركز في الكلية	
٤	أ.د. إبراهيم المطاع	نائب رئيس الجامعة للشؤون الأكاديمية	

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