

Module specification

1. Factual information			
Module title	TM298: Operating Systems	Level	2
Module tutor	TBA	Credit value	15
Module type	Taught	Notional learning hours	4

2. Rationale for the module and its links with other modules

The study of Operating Systems is essential since these are an integral part of modern IT systems. This is an introductory level module which introduces students to fundamental concepts of a variety of operating systems.

3. Aims of the module

The module aims to:

- Provide students extensive knowledge on OS in general, OS principles and modules and how their internals work and functions.
- Provide key mechanisms in design of operating systems modules.
- Introduce students to definitions of the Operating Systems such as OS control all of a computer's resources and present users with the equivalent of virtual machines that are easier to program than their underlying hardware.
- Teach core operating systems concepts including operating system structure, process management, synchronization and concurrency, threads, memory management techniques, process scheduling and resource management, virtual memory concepts, deadlocks.
- Give an overview of fundamental operating system principles, complemented with discussions of concrete modern systems to help students understand how these principles are applied in real OSs.
- Enable students to compare performance of processor scheduling algorithms.
- Teach students to produce algorithmic solutions to process synchronization problems.
- Provide students with a good grasp of basic abstractions employed in system-level software (such as processes, threads, virtual memory, caching, etc.),
- Teach students to use modern operating system calls such as Linux process and synchronization libraries.
- Develop a sense in understand designing and implementing systems and working as part of a team.

4. Pre-requisite modules or specified entry requirements

Students must have successfully completed TM105 and TM103.

5. Intended learning outcomes	
A. Knowledge and understanding	Learning and teaching strategy
<p>After completing this module, students will be able to:</p> <p>A1. Identify and learn what operating systems are, what they do. A2. Describe How the Operating System are designed and constructed. A3. Show what the common features of an operating system are. A4. Explain what an operating system does for the user, and what it does for the computer-system operator.</p>	<ul style="list-style-type: none"> • 25% face-to-face tutorial sessions • TMA work • Module Text book, note slides and support material
B. Cognitive skills	Learning and teaching strategy
<p>After completing this module, students will be able to:</p> <p>B1. Analyze the operating system design, constructor, building, internal works, usage variety, operations, and functions. B2. Demonstrate the basis for future work in other areas of OS: hacking Linux, i.e. contribute to the Open source OS, security and so on.</p>	<ul style="list-style-type: none"> • 25% face-to-face tutorial sessions • TMA work • Module Text book, note slides and support material
C. Practical and professional skills	Learning and teaching strategy
<p>After completing this module, students will be able to:</p> <p>C1. Implement the design simple of Operating System structures. C2. Demonstrate basic skills to enable you to progress to more advanced level studies at the AOU or any other university.</p>	<ul style="list-style-type: none"> • 25% face-to-face tutorial sessions • TMA work • Module Text book, note slides and support material
D. Key transferable skills	Learning and teaching strategy

C. Practical and professional skills	Learning and teaching strategy
<p>After completing this module, students will be able to:</p> <p>D1. Demonstrate study skills at a level appropriate to higher education, such as timetabling study; read critically for meaning and take effective notes; and use study aids such as dictionaries and glossaries;</p> <p>D2. Identify and distinguish between number of concepts that inform the Operating system structure components.</p> <p>D3. Communicate appropriately with your tutor and other students using email, online conferences and forums;</p> <p>D4. Locate information on a given subject from the World Wide Web.</p>	<ul style="list-style-type: none"> • 25% face-to-face tutorial sessions • TMA work • Module Text book, note slides and support material

6. Indicative content.
<p>The module includes 9 units from three parts.</p> <p>PART ONE OVERVIEW</p> <p>Chapter 1 Introduction</p> <p>1.1 What Operating Systems Do</p> <p>1.2 Computer-System Organization</p> <p>1.3 Computer-System Architecture</p> <p>1.4 Operating-System Structure</p> <p>1.5 Operating-System Operations</p> <p>1.6 Process Management</p> <p>1.7 Memory Management</p> <p>1.8 Storage Management</p> <p>1.9 Protection and Security</p> <p>1.10 Distributed Systems</p>

6. Indicative content.

1.11 Special-Purpose Systems

1.12 Computing Environments

1.13 Open-Source Operating Systems

1.14 Summary

Chapter 2 Operating-System Structures

2.1 Operating-System Services

2.2 User Operating-System Interface

2.3 System Calls

2.4 Types of System Calls

2.5 System Programs

2.6 Operating-System Design and Implementation

2.7 Operating-System Structure

2.8 Virtual Machines

2.9 Operating-System Debugging

2.10 Operating-System Generation

2.11 System Boot

2.12 Summary

PART TWO PROCESS MANAGEMENT

Chapter 3 Processes

3.1 Process Concept

3.2 Process Scheduling

3.3 Operations on Processes

3.4 Interprocess Communication

3.5 Examples of IPC Systems

3.6 Communication in Client–Server Systems

3.7 Summary

Chapter 4 Threads

4.1 Overview

4.2 Multithreading Models

4.3 Thread Libraries

6. Indicative content.

- 4.4 Threading Issues
- 4.5 Operating-System Examples
- 4.6 Summary
- Chapter 5 CPU Scheduling
 - 5.1 Basic Concepts
 - 5.2 Scheduling Criteria
 - 5.3 Scheduling Algorithms
 - 5.4 Thread Scheduling
 - 5.5 Multiple-Processor Scheduling
 - 5.6 Operating System Examples
 - 5.7 Algorithm Evaluation
 - 5.8 Summary
- Chapter 6 Process Synchronization
 - 6.1 Background
 - 6.2 The Critical-Section Problem
 - 6.3 Peterson's Solution
 - 6.4 Synchronization Hardware
 - 6.5 Semaphores
 - 6.6 Classic Problems of Synchronization
 - 6.7 Monitors
 - 6.8 Synchronization Examples
 - 6.9 Atomic Transactions
 - 6.10 Summary
- Chapter 7 Deadlocks
 - 7.1 System Model
 - 7.2 Deadlock Characterization
 - 7.3 Methods for Handling Deadlocks
 - 7.4 Deadlock Prevention
 - 7.5 Deadlock Avoidance
 - 7.6 Deadlock Detection

6. Indicative content.

7.7 Recovery from Deadlock

7.8 Summary

PART THREE MEMORY MANAGEMENT

Chapter 8 Main Memory

8.1 Background

8.2 Swapping

8.3 Contiguous Memory Allocation

8.4 Paging

8.5 Structure of the Page Table

8.6 Segmentation

8.7 Example: The Intel Pentium

8.8 Summary

Chapter 9 Virtual Memory

9.1 Background

9.2 Demand Paging

9.3 Copy-on-Write

9.4 Page Replacement

9.5 Allocation of Frames

9.6 Thrashing

9.7 Memory-Mapped Files

9.8 Allocating Kernel Memory

9.9 Other Considerations

9.10 Operating-System Examples

9.11 Summary

7. Assessment strategy, assessment methods and their relative weightings

TMA Work: 20%

MTA: 30%

Exam: 50%

8. Mapping of assessment tasks to learning outcomes												
Assessment tasks	Learning outcomes											
	A1	A2	A3	A4	B1	B2	C1	C2	D1	D2	D3	D4
TMA	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
MTA	✓	✓	✓				✓	✓		✓	✓	✓
Final	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

9. Teaching staff associated with the module
Name and contact details
Dr. Alaa Ismaeel (GCC) , alaa.ismaeel@aou.edu.om

10. Key reading list				
Author	Year	Title	Publisher	Location
A. Silberschatz, P. B. Galvin, G. Gagne ISBN: 978-1-118-06333-0	2013	Operating System Concepts, 9 th Ed.	John Wiley & Sons, Inc.	
Andrew S. Tanenbaum, Herbert Bos ISBN-10: 13: 978-0-13-359162-0	2015	Modern Operating system, 4 th Ed.	Pearson	
William Stallings ISBN: 978-0-13-380591-8	2015	Operating Systems: internals and design principles, 8 th Ed.	Pearson	
Douglas Comer ISBN13: 978-1498712439	2015	Operating System Design: The Xinu Approach, 2nd Ed.	CRC Press	

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Author	Year	Title	Publisher	Location
Andrew S. Tanenbaum, Albert S Woodhull ISBN-13: 978-0131429383	2006	Operating System design and Implementation, 3 rd Ed.	Pearson	
Gary Nutt ISBN-13: 978-0321362193	2004	Operating system, 3 rd Ed.	Addison Wesley	
W .R. Stevens, S. A. Rago ISBN-13: 978-0321637734	2005	Advanced programming in the Unix environment, 2 nd Ed.	Addison-Wesley Professional	
William Satllings ISBN-13: 978-0134101613	2015	Computer organization and architecture: designing for performance, 10 th Ed.	Prentice Hall	
David Patterson, John L. Hennessy ISBN-13: 9780124077263	2013	Computer Organization and design: The hardware/software interface, 5 th Ed.	Morgan Kaufmann	
Max Hailperin	2016	Operating systems and Middleware: Supporting controlled interaction, Rev.Ed.		

11. Other indicative text (e.g. websites)
https://lms.arabou.edu.kw/ http://os-book.com/