



**COLLEGE OF INFORMATION TECHNOLOGY**  
**DEPARTMENT OF INFORMATION TECHNOLOGY**  
**COURSE SYLLABUS/ SPECIFICATION**

**Course Code & Title:** ITCS 422 - Distributed Systems

**Weight:** 2-2-3

**Prerequisite:** ITCS 409

**NQF Level Allocated:** 8

**NQF Notional Hours / Credits:** 120 notional hours/ 12 NQF credit

**Description:** The course focuses on the key aspects of distributed systems. It imparts knowledge of distributed systems principles, design, and implementation. It covers transparency in a distributed system, architectures, processes, virtualization, RPC, message passing, communication, quality of service, and naming.

**Objective:**

1. To critically understand the concepts, specialist theories, and techniques behind the design of distributed systems.
2. To analyze the clustering and cluster computing.
3. To apply simulation tools in distributed systems problems solving.
4. To develop advanced skills for selecting appropriate solutions to meet the user requirements.

**Semester:**

**Instructor (s):**

**Office Telephone:**

**Email (s):**

### Intended Learning Outcomes (ILOs):

A. Knowledge and Understanding		NQF Descriptor/ Level
A1	<b>Concepts and Theories:</b> Demonstrate critical understanding of concepts, and specialized theories relating to distributed systems.	Knowledge: theoretical understanding [Level 8]
A2	<b>Contemporary Trends, Problems and Research:</b> Recognize up-to-date trends, applications, tools available, and methods in distributed systems.	Knowledge: theoretical understanding [Level 8]
A3	<b>Professional Responsibility:</b> N/A	
B. Subject-specific Skills		NQF Descriptor/ Level
B1	<b>Problem Solving:</b> Identify real life problems and solve them by designing efficient and effective distributed systems.	Knowledge: Practical Application [Level 8] Skills: Communication, ICT & Numeracy [Level 8]
B2	<b>Modeling and Design:</b> Design distributed systems by choosing appropriate components and models that satisfy user specifications.	Knowledge: Practical Application [Level 8]
B3	<b>Application of Methods and Tools:</b> Apply simulation software tools to solve the problems of distributed computing.	Knowledge: Practical Application [Level 8] Skills: Communication, ICT & Numeracy [Level 8]
C. Critical-Thinking Skills		NQF Descriptor/ Level
C1	<b>Analytic skills:</b> Critically analyze a problem and user specification to choose the appropriate distributed system architecture to solve this problem.	Generic Problem Solving & Analytical skills [Level 8]
C2	<b>Synthetic:</b> Integrate the components of distributed systems into incorporated system.	Generic Problem Solving & Analytical skills [Level 8]
C3	<b>Creative Thinking and innovation:</b> Demonstrate creativity in designing distributed systems for new applications.	Generic Problem Solving & Analytical skills [Level 8]
D. General and Transferable Skills (other skills relevant to employability and personal development)		NQF Descriptor/ Level
D1	<b>Communication:</b> Show ability to communicate information in appropriate oral and written forms.	Communication, ICT and Numeracy Skills [Level 8]
D2	<b>Teamwork and Leadership:</b> Show ability to work effectively as a member/leader of a development team.	Competence: Autonomy, Responsibility and

		Context [Level 8]
<b>D3</b>	<b>Organizational and Developmental Skills:</b> Demonstrate ability to organize ideas and effectively allocate time in given assignment.	Competence: Autonomy, Responsibility and Context [Level 8]
<b>D4</b>	<b>Ethics and Social Responsibility:</b> N/A	

### Course Structure (Outline)

Course Structure (Outline)						
Week	Hours		ILOs	Topics	Teaching Method	Assessment Method
	Lec.	Lab				
1	2	2	A1	<b>Introduction:</b> Introduction to Distributed System	Lecture/ Lab Demonstration	
2	2	2	A1	<b>Definitions, Goals, and Examples:</b> Definitions and Goals of Distributed System, Real Examples of Distributed Systems	Lecture/ Class Discussion/Lab Demonstration	Oral Participation
3	2	2	A1, B2, B3	<b>Challenges in Distributed System Design:</b> Lack of global knowledge, Scalability, Communication Cost, Transparency, Security, Mobility	Lecture/ lab Demonstration	Oral Participation/ In-Lab Exercises
4	2	2	A1, B1, B3, C1	<b>Architectures:</b> Architectures-I Layered Architectures Architectures-II Object-Based Architectures	Lecture/ In-Class and In-Lab Supervised Work	In-Lab Exercises Quiz1
5	2	2	A1, B1, B3,	<b>Architectures:</b>	Lecture/ In-Class and In-	In-Lab Exercises

			C1	Architectures-III Data-Centered Architectures Architectures-VI Event-based Architectures	Lab Supervised Work	
6	2	2	A1, B1, C1	<b>Network as a graph:</b> Spanning Tree and MST, Traversal of graphs, Broadcasting messages, Communication complexity	Lecture/ In-Class and In-Lab Supervised Work	In-Lab Exercises
7	2	2	A1, A2, B1, B2, B3, C1, C2, C3, D3	<b>P2P:</b> P2P Algorithms	Lecture/ In-Lab Supervised Work/ Independent Learning	Assignment/ In-Lab Exercises
8	2	2	A1, B1, B2, B3, C1, C2	<b>Process and Thread:</b> Process Thread, Thread Implementation	Lecture/ In-Lab Supervised Work	In-Lab Exercises Quiz2
9	2	2	A1, B1, C1	<b>Time synchronization:</b> Time synchronization in Distributed System	Lecture/ In-Lab Supervised Work	In-Lab Exercises/ Major Test
10	2	2	A1, B1, B3, C1, C2	<b>Virtualization</b>	Lecture/ Class Discussion/ In-Lab Supervised Work	In-Lab Exercises/ Oral Participation
11	2	2	A1, B1	<b>Communication and Modeling:</b> Communication Fundamentals	Lecture/ In-Lab Supervised Work	In-Lab Exercises
12	2	2	A1, B1, B3, C1, C2	<b>Communication and Modeling:</b> Communication	Lecture/ In-Class and In-Lab	Oral Participation/ In-Lab Exercises

				between Nodes, RPC	Supervised Work	Quiz3
13-14	4	4	A1, C1, C2, B1, B2	<b>Distributed Database:</b> Distributed transaction management, Distributed concurrency control, Distributed deadlock handling, Maintaining consistency	Lecture/ In-Lab Supervised Work	In-Lab Exercises
15	2	2	A2, B1, B2, C1, C2, C3, D1, D2, D3	Student Project	Project Supervision	Evaluation of Project Presentations and Reports
16			A1, B1, B2, C1, C2	All Topics		Final Exam

### Teaching Materials:

<b>Textbook(s):</b>	1. Tanenbaum A. and Steen M. V. (2017) <i>Distributed Systems And networks</i> , 3 <sup>rd</sup> Edition, Prentice Hall.
<b>Handout(s):</b>	Available on Moodle i.e. <a href="http://www.ahlia.edu.bh/moodle">http://www.ahlia.edu.bh/moodle</a>
<b>Reference(s):</b>	1. Tanenbaum A. and Steen M. V. (2013) <i>Distributed Systems Principles and Paradigms</i> , 2 <sup>nd</sup> Revised Edition, Pearson Education Limited. 2. Coulouris G. and Halsall F. (2005) <i>Distributed Systems: Concepts and Design with Computer Networking and the Internet</i> , 4 <sup>th</sup> Edition, Addison Wesley.

### Assessment

Method of Assessment	Description	Learning Outcomes	Weighting
Oral Participation	Students will be questioned orally to demonstrate their understanding and knowledge of the topics covered during class lectures and lab sessions.	A1	Formative
Quizzes	Three written quizzes to be conducted where the average of best two quizzes will be considered.	A1, B1	10%
Assignment	The assignment consists of essay, problem-	A1, A2, B1, B2,	10%

	solving and research based theoretical questions regarding topics in distributed system. The purpose of the assignment is to assess students where they have to demonstrate their extensive and detailed knowledge and critical understanding of key concepts of distributed system.	C1, C2, C3, D3	
Major Test	The test will be an in-class 90 minutes exam that will consist of short-answer, essay, and problem solving questions and cover the topics studied in the first 8 weeks.	A1, B1, B2, C1	20%
In-Lab Exercises	Each of the practical exercises consists of a set of practical tasks to be implemented by students individually in lab as shown in the above weekly structure. Each of the exercises assesses the students' skills in the application of distributed systems. Students work will be observed and evaluated directly during the lab sessions.	B1, B2, B3	5%
Project	Starting from weak 4, the class will be divided into teams of 2-3 students where each team will be asked to develop a small distributed system application.	A2, B1, B2, C1, C2, C3, D1, D2, D3	15%
Final Exam	The final exam is comprehensive and will be of two hours duration. It will consist of short-answer, essay and problem-solving questions.	A1, B1,B2, C1, C2	40%
<b>Overall:</b>			<b>100 %</b>

Admissions	
<b>Minimum number of students</b>	<b>5</b>
<b>Maximum number of students</b>	<b>20</b>

**Ahlia University values academic integrity. Therefore, all students must understand the meaning and consequences of cheating, plagiarism and other academic offences under the Code of Student Conduct and Disciplinary Procedures (see [www.ahlia.edu.bh/integrity](http://www.ahlia.edu.bh/integrity) for more information).**