CENG 427 – DISTRIBUTED SYSTEMS

Course Code	Course Name		Semester	
CENG 427	Distributed Systems		Fall ☐ Spring ☒ Summer ☐	
Hours			Credit	ECTS
Theory	Practice	Lab	3	5
3	-	-		

Course Details	
Department	Computer Engineering
Course Language	English
Course Level	Undergraduate ☒ Graduate ☐
Mode of Delivery	Face to Face ☒ Online ☐ Hybrid ☐
Course Type	Compulsory ☐ Elective ☒
Course Objectives	By the end of this course, students will have a comprehensive understanding of the fundamental principles of distributed systems, including their benefits and challenges. They will develop the ability to analyze concurrency issues and implement appropriate synchronization mechanisms. Students will gain insights into process management. They will explore various communication models, and assess their impact on performance and reliability. The course will also cover naming schemes and name resolution techniques. Students will learn about coordination and synchronization mechanisms to ensure system consistency. A key focus will be on fault tolerance, where students will analyze fault models and explore recovery techniques such as checkpointing and replication. Security challenges in distributed systems will also be addressed. Finally, students will apply their knowledge by designing, implementing, and evaluating distributed applications, ensuring they can assess system performance, scalability, and reliability in real-world scenarios.
Course Content	Introduction, Concurrency, Processes, Communication, Naming, Coordination, Consistency and Replication, Fault Tolerance, Security
Course Method/ Techniques	Lecture ☒ Question & Answer ☒ Presentation ☐ Discussion ☒
Prerequisites/ Corequisites	
Work Placement(s)	

Textbook/References/Materials

- Distributed Systems, M. van Steen and A. S. Tanenbaum, Fourth Ed., 2023

Course Category				
Mathematics and Basic Sciences	☐		Education	☐
Engineering	☒		Science	☐
Engineering Design	☐		Health	☐
Social Sciences	☐		Profession	☐

Weekly Schedule		
No	**Topics**	**Materials/Notes**
1	**Introduction:** From networked systems to distributed systems, Design goals, A simple classification of distributed systems, Pitfalls	
2	**Architecture:** Architectural styles, Middleware and distributed systems, Layered-system architectures	
3	Symmetrically distributed systems architectures, Hybrid system architectures	
4	**Processes:** Threads, Virtualization, Clients, Servers, Code migration	
5	**Communication:** Foundations, Remote produce call	
6	Message-oriented communication, Multicast communication	
7	**Coordination:** Clock synchronization, Logical clocks, Mutual exclusion, Election algorithms, Gossip-based coordination, Distributed event matching, Location systems	
8	**Midterm Exam**	
9	**Naming:** Names, identifiers, and addresses, Flat naming	
10	Structured naming, Attribute-based naming, Named-data networking	
11	**Consistency and replication:** Introduction, Data-centric consistency models, Client-centric consistency models, Replica management, Consistency protocols	
12	**Fault tolerance:** Introduction to fault tolerance, Process resilience, Reliable client-server communication	
13	Reliable group communication, Distributed commit	
14	**Security:** Introduction to security, Cryptography, Authentication, Trust in distributed systems, Authorization, Monitoring	
15	**Final Exam**	

Assessment Methods and Criteria		
In-term studies	**Quantity**	**Percentage**
Attendance	12	6
Lab		
Practice		
Fieldwork		
Course-specific internship		
Quiz/Studio/Criticize		
Homework	2	14
Presentation / Seminar		
Project		
Report		
Seminar		
Midterm Exam	1	30
Final Exam	1	50

	Total	100%
Contribution of Midterm Studies to Success Grade		50%
Contribution of End of Semester Studies to Success Grade		50%
	Total	100%

ECTS Allocated Based on Student Workload			
Activities	**Quantity**	**Duration (Hrs)**	**Total Workload**
Course Hours	14	3	42
Lab			
Practice			
Fieldwork			
Course-specific Work Placement			
Out-of-class study time	14	2	28
Quiz/Studio/Criticize			
Homework	3	5	15
Presentation / Seminar			
Project			
Report			
Midterm Exam and Preparation for Midterm	1	20	20
Final Exam and Preparation for Final Exam	1	20	20
Total Workload			125
Total Workload / 25			5
ECTS Credit			5

Course Learning Outcomes	
No	**Outcome**
L1	Understanding fundamental concepts of distributed systems
L2	Analyzing concurrency in distributed systems
L3	Managing processes in distributed systems
L4	Implementing communication and fault tolerance mechanisms
L5	Applying naming techniques in distributed systems
L6	Understanding coordination and synchronization
L7	Ensuring consistency and replication
L8	Addressing security challenges in distributed systems

Program Competencies	
No	**Outcome**
P1	Sufficient knowledge in subjects specific to mathematics, natural sciences, and computer engineering; the ability to use theoretical and practical knowledge in these fields to solve complex engineering problems.
P2	The ability to identify, define, formulate, and solve complex engineering problems; the ability to select and apply appropriate analysis and modeling methods for this purpose.
P3	The ability to design a complex system, process, device, or product to meet specific requirements under realistic constraints and conditions; the ability to apply modern design methods for this purpose.

P4	The ability to develop, select, and utilize the modern techniques and tools necessary for the analysis and solution of complex problems encountered in engineering applications; the ability to effectively use information technologies.
P5	The ability to design experiments, conduct experiments, collect data, analyze results, and interpret findings for the investigation of complex engineering problems or research topics specific to the field of computer engineering.
P6	The ability to work effectively in interdisciplinary and multidisciplinary teams; individual working skills.
P7	The ability to communicate effectively in Turkish, both verbally and in writing; knowledge of at least one foreign language; skills in writing effective reports and understanding written reports, preparing design and production reports, making effective presentations, and giving and receiving clear and understandable instructions.
P8	Awareness of the necessity of lifelong learning; the ability to access information, follow developments in science and technology, and continuously renew oneself.
P9	Adherence to ethical principles, awareness of professional and ethical responsibilities; knowledge about the standards used in engineering practices.
P10	Knowledge of applications in business life, such as project management, risk management, and change management; awareness of entrepreneurship and innovation; knowledge about sustainable development.
P11	Knowledge about the effects of engineering applications on health, environment, and safety at universal and societal levels, and the issues reflected in the engineering field of the age; awareness of the legal consequences of engineering solutions.

Contribution of Course Learning Outcomes to Program Competencies/Outcomes											
	P1	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**P9**	**P10**	**P11**
L1	✓										
L2		✓									
L3			✓								
L4			✓								
L5				✓							
L6				✓							
L7				✓							
L8				✓							