TED UNIVERSITY, COURSE SYLLABUS

Faculty	Engineering	**Department**	Computer Engineering

Course Code & Number	**CMPE 322**	**Course Title**	**Theory of Computation**
Type of Course	☑ Compulsory ☐ Elective	**Semester**	☐ Fall ☑ Spring ☐ Summer
Level of Course	BSc	**Year of Study**	Junior/Senior
Course Credit Hours	(3+0+0) 3	**Number of ECTS Credits**	6
Pre-requisite	N/A	**Co-requisite**	N/A
Mode of Delivery	☑ Face-to-face ☐ Distance learning	**Language of Instruction**	☑ English ☐ Turkish
Course Lecturer	Burak Ekici	**Course Assistant**	Merve Işıl Peten Ali Egemen Taşören
Required Reading	Automata and Computability, Dexter C Kozen, Springer-Verlag, 1997	**Recommended Reading**	1. Hopcroft, Motwani, Ullman, Introduction to Automata Theory, Languages, and Computation, 3rd Edition. 2. Introduction to the theory of computation, Michael Sipser. 3. An Introduction to Formal Languages and Automata, Peter Linz.

Course Catalog Description	Deterministic Finite Automata. Regular Languages. Non-deterministic Finite Automata. Closure Properties of Regular Languages. Regular Expressions. Myhill-Nerode Relations. Kleene Algebra. Equivalence of Regular Expressions and Finite Automata. Context-Free Grammars. Context-Free Languages. Chomsky and Greibach Normal Forms. Pumping Lemma. Ogden's Lemma. Push-Down Automata. Closure Properties of Context-Free Languages. Turing Machines. Recursive and Recursively-Enumerable Languages. Decision Problems. Halting Problem. Membership Problem. Reduction. Rice's Theorem.
Course Objectives	The objective of this course is to provide an understanding of the theory of automata, computability of problems and complexity of computations. Different models of computation will be introduced and their comparisons will be done.
Course Learning Outcomes	Upon successful completion of this course, a student will be able to 1. develop deterministic finite state automata (DFA), non-deterministic finite stateautomata (NFA) and NFA with epsilon transition that recognize regular languages (RL) constructed by regular expressions (REGEXP); 2. apply epsilon elimination to handle equivalent NFAs out of epsilon-NFAs, subset construction to obtain equivalent DFAs out of NFAs, and minimize given DFAs; 3. simplify REGEXPs employing Kleene Algebra Axioms, decide (non-)equivalences of REGEXPs via derivations and bisimulation up-to techiques; 4. develop NPDA that recognize CFLs constructed by CFGs; 5. normailze CFGs into Chomsky and Greibach Normal Forms, and solve membership problem for CFLs employing CKY algorithm; 6. benefit contra-positive of the Pumping Lemma and Ogden's Lemma to prove that a given language cannot be context free; 7. develop TMs that recognize recursive(ly enumerable) languages constructed by unrestricted grammars.

Teaching Methods & Learning Activities	☑ Telling/Explaining ☑ Discussions/Debates ☑ Questioning ☑ Reading ☐ Peer teaching ☐ Scaffolding/Coaching ☑ Demonstrating ☑ Problem solving ☐ Inquiry ☐ Collaborating ☐ Think-Pair-Share ☐ Predict-Observe-Explain ☐ Microteaching ☑ Case Study/Scenario Analysis	☐ Simulations & Games ☐ Video Presentations ☐ Oral presentations/Reports ☐ Concept Mapping ☐ Brainstorming ☐ Drama/Role Playing ☐ Seminars ☐ Field Trips ☐ Guest Speakers ☑ Hands-on Activities ☐ Service Learning ☐ Web Searching ☑ Experiments ☐ Other(s): .....
Assessment Methods (Formal & Informal)	☐ Test/Exam ☑ Quiz/Homework ☐ Oral Questioning ☐ Laboratory work ☐ Performance Project	☐ Observation ☐ Self-evaluation ☐ Peer-evaluation ☐ Portfolio ☐ Presentation (Oral, Poster) ☐ Other(s): .....

Student Workload (Total 147 Hrs)	☑ Lectures ..... 42 hrs ☑ Course Readings ..... 35 hrs ☐ Workshop ..... hrs ☐ Online Discussion ..... hrs ☐ Debate ..... hrs ☐ Work Placement ..... hrs ☐ Field Trips/Visits ..... hrs ☐ Observation ..... hrs ☐ Laboratory Applications ..... hrs ☑ Quizzes ..... 30 hrs ☐ Hands-on Work ..... hrs ☑ Homework .....40 hrs	☐ Midterm I ..... hrs ☐ Midterm II ..... hrs ☐ Final ..... hrs ☐ Resource Review ..... hrs ☐ Research Review ..... hrs ☐ Report on a Topic ..... hrs ☐ Case Study Analysis ..... hrs ☐ Oral Presentation ..... hrs ☐ Poster Presentation ..... hrs ☐ Demonstration ..... hrs ☐ Web Designs ..... hrs ☐ Mock Designs ..... hrs ☐ Team Meetings ..... hrs ☐ Other ..... hrs

COURSE ASSIGNMENTS
A. Homeworks [80 points]
There are 4 homeworks; 20 points each.
B. Quizzes [20 points]
There are 3 quizzes; 10 points each. The lowest grade among all is discarded.

COURSE GRADING
A. Quizzes and Homeworks [35%]
B. Midterm [30%]
C. Final [35%]

COURSE POLICIES
I . Attendance
Attendance to the course is mandatory. **The students attending less than 70% of Lecture Hours will get "FX" grade.**
II . Missed Work
Missed works will not be tolerated.

III. Late Assignment Submission Policy

Late submissions will not be graded.

IV. Extra Credit

Extra credits will not be offered.

V . Assignment Rules

All assignment works must be done individually. A student can submit only one work. In case of multiple submissions, only the latest submission will be considered. Students cannot submit work on other students' behalf.

VI. Plagiarism

All of the following are considered plagiarism:

- turning in someone else's work as your own
- copying words or ideas from someone else without giving credit
- failing to put a quotation in quotation marks
- giving incorrect information about the source of a quotation
- changing words but copying the sentence structure of a source without giving credit
- copying so many words or ideas from a source that it makes up the majority of your work, whether you give credit or not" (www.plagiarism.org)

Plagiarism is a very serious offense and will be penalized accordingly by the university disciplinary committee. The best way to avoid accidentally plagiarizing is to work on your own before you ask for the help of other resources.

VII. Cheating

Cheating has a very broad description which can be summarized as "acting dishonestly". Some of the things that can be considered as cheating are the following:

- Copying answers on examinations, homework and laboratory works,
- Using prohibited material on examinations,
- Lying to gain any type of advantage in class
- Providing false, modified or forged data in a report
- Plagiarizing
- Modifying graded material to be regraded.
- Causing harm to colleagues by distributing false information about an examination, homework or laboratory

Cheating is a very serious offense and will be penalized accordingly by the university disciplinary committee.

VIII. Class Participation

Participation in class is necessary but not mandatory. By actively participating in class, you can improve your learning process and immediately confirm what you have earned and what you have not internalized. Do not forget that you are not expected to know all of the material being discussed in class. Actually, you are expected not to know it. Therefore, there is no point in being hesitant to join a conversation or ask a question.

IX. Class Readings

Class readings are necessary but not mandatory. The material covered in class by your instructor will only provide a fundamental understanding of the general context. If you are willing to effectively learn something, you must actively work on it yourself. Reading is one of the most successful ways of learning about a topic.

TENTATIVE COURSE OUTLINE				
		Topic	**Reading**	**Homeworks / Exams**
W0	14.02-18.02	History of Computing – An Overview	• Lecture 1	
W1	21.02-25.02	Central Concepts of Automata Theory Mathematical Preliminaries	• Lecture 2	
W2	28.02-04.03	Deterministic Finite Automata (DFA) Closure Properties	• Lecture 3 • Lecture 4	
W3	07.03-11.03	Non-Deterministic Finite Automata (NFA): Regular Languages	• Lecture 5 • Lecture 6	*HW-1*
W4	14.03-18.03	Pattern Matching Regular Expressions	• Lecture 7 • Lecture 8 • Lecture 9 • Lecture 10	*Quiz-1*
W5	21.03-25.03	DFA State Minimization Myhill-Nerode Relations	• Lecture 13 • Lecture 14 • Lecture 15 • Lecture 16	
W6	28.03-01.04	Derivatives Kleene Algebra Equivalence of Regular Expressions	• Supplementary Lecture A • J. A. Brzozowski, Derivatives of Regular Expressions • A. Krauss and T. Nipkow, Regular Expression Equivalence and Relation Algebra	*HW-2*
W7	04.04-08.04	**Midterm Exam – exact timing to be announced**		
W8	11.04-15.04	DFA Equivalence Checking Context Free Grammars Ambiguity	• Lecture 19 • Lecture 20	
W9	18.04-22.04	Chomsky Normal Form Pumping Lemma CKY Algorithm	• Lecture 21 (except for section on Greibach Normal Form) • Lecture 22 • Lecture 27 (except for sections on Closure Properties)	*Quiz-2*
W10	25.04-29.04	Ogden's Lemma Push Down Automata	• Lecture 23 • Supplementary Lecture E • Lecture 24 (proofs can be skipped) • Lecture 25 (proofs can be skipped) • Lecture 27 (sections on Closure Properties)	*HW-3*
W11	02.05-06.05	**Potential Break – details to be announced**		
W12	09.05-13.05	Turing Machines Decision Problems	• Lecture 28 • Lecture 29 • Lecture 30 • Lecture 31 (except for section on Undecidability of Halting Problem)	
W13	16.05-20.05	Halting Problem Reduction	• Lecture 31 • Lecture 32 • Lecture 33	*Quiz-3*
W14	23.05-27.05	Rice's Theorem Unrestricted Grammars	• Lecture 33 • Lecture 34 (only statement and proof of Theorem 34.1) • Lecture 36 (only section on	*HW-4*

			Type 0 Grammars)	
W15	30.05-10.06	**Final Exam – exact timing to be announced**		