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|  |  | **ECTS Course Description Form** |
|  | **PART I ( Senate Approval)** |
|  | **Offering School**  | **Engineering** |
|  | **Offering Department** | **Computer Engineering** |
|  | **Program(s) Offered to** | **Computer Engineering** | **Compulsory** |
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|  | **Course Code**  | **CS310** |
|  | **Course Name** | **Formal Languages and Automata Theory** |
|  | **Language of Instruction** | **English** |
|  | **Type of Course** | **Compulsory - Lectures** |
|  | **Level of Course** | **Undergraduate** |
|  | **Hours per Week** | **Lecture: 3** | **Laboratory:** | **Recitation:**  | **Practical:**  | **Studio:** | **Other:** |
|  | **ECTS Credit** | **6** |
|  | **Grading Mode** | **Letter Grade** |
|  | **Pre-requisites** | **CS213** |
|  | **Co-requisites** |  |
|  | **Registration Restriction** |  |
|  | **Educational Objective** | **The main objective of this course is to help students gain** **(1) Basic understanding of fundamental concepts in theory of computation****(2) Knowledge on theoretical foundations of problem solving** **(3) Experience in written communication skills, especially regarding formal proofs** |
|  | **Course Description** | **Introduction to the main concepts regarding models of computation used throughout computer science: finite automata, pushdown automata, and Turing machines. The hierarchical relationships among these models, their relative power and limitations, and their variants are studied. Student skills are developed in using rigorous definitions and proofs to solve questions about computability and computation. Topics covered include: Finite automata, regular expressions, regular languages and their properties, pumping lemma for regular languages, context-free grammars, pushdown automata, pumping lemma for context-free languages, Turing machines and their properties, Church-Turing thesis, undecidable problems and reducibility.** |
|  | **Learning Outcomes**  | **LO1: Interpret and analyse models for regular languages: FA and regular expressions** |  |
|  | **LO2: Interpret and analyse models for context-free languages: CFG and pushdown automata** |
|  | **LO3: Analyse the Turing machine model, explain the Church-Turing thesis and its significance.** |
|  | **LO4: Determine a language’s place in the Chomsky hierarchy (regular, context-free, recursive, recursively enumerable)** |
|  | **LO5: Convert among equivalently powerful notations for a language, including among DFAs, NFAs, and regular expressions, and between PDAs and CFGs** |
|  | **LO6: Provide examples of incomputable functions and prove that a problem is incomputable by reducing a classic known incomputable problem to it** |
|  | **PART II ( Faculty Board Approval)** |
|  | **Basic Outcomes (University-wide)** | **No.** | **Program Outcomes** | **LO1** | **LO2** | **LO3** | **LO4** | **LO5** | **LO6** |
|  | **PO1** | **Ability** to communicate effectively and write and present a report in Turkish and English.  | *2 2 2 2 2 2*111 ***1 1 1*** ***2 2 2 2 2 2*** ***0 0 0 0 0 0*** ***0 0 0 0 0 0*** ***0 0 0 0 0 0*** ***2 2 2 2 2 2*** ***0 0 0 0 0 0*** ***3 3 3 3 3 2*** ***0 0 0 0 0 0*** ***3 3 3 3 3 3*** ***0 0 0 0 0 0*** ***0 0 0 0 0 0*** |
|  | **PO2** | **Ability** to work individually, and in intra-disciplinary and multi-disciplinary teams. |
|  | **PO3** | **Recognition** of the need for life-long learning and **ability** to access information, follow developments in science and technology, and continually reinvent oneself. |
|  | **PO4** | **Knowledge** of project management, risk management, innovation and change management, entrepreneurship, and sustainable development. |
|  | **PO5** | **Awareness** of sectors and **ability** to prepare a business plan. |
|  | **PO6** | **Understanding** of professional and ethical responsibility and **demonstrating** ethical behaviour. |
|  | **Discipline Specific Outcomes (Faculty/program)** | **PO7** | **Ability** to define complex engineeringproblems, develop models andimplement solutions for theseproblems. |
|  | **PO8** | **Ability** to conduct lab experiments by usingcomputers and the ability of collecting, analysing and interpreting data.  |
|  | **PO9** | **Ability** to apply the knowledge ofmathematics, science and engineeringprinciples to solve problems in computerengineering. |
|  | **PO10** | An **understanding** of current contemporaryissues and impact of engineering solutionsin legal and ethical levels. |
|  | **PO11** | **Ability** to understand and apply discretemathematics concepts. |
|  | **PO12** | **Ability** to use modern engineeringtechniques, tools and informationtechnologies and develop softwareequipment and software. |
|  | **PO13** | **Ability** to analyse, design and manage thehardware/software computer systemrequirements with limited resources andconditions by modern engineeringprinciples. |
| **PART III ( Department Board Approval)** |
| **Course Subjects, Contribution of Course Subjects to Learning Outcomes, and Methods for Assessing Learning of Course Subjects** | **Subjects** | **Week** |  | **LO1** | **LO2** | **LO3** | **LO4** | **LO5** | **LO6** |
| **S1** | 1 | General overview of the course, relationship between languages and computational problems, hierarchy of languages |  |  |  | A1/3 |  |  |
| **S2** | 2 | Regular languages, deterministic finite automata, nondeterministic finite automata | A1/3 |  |  |  |  |  |
| **S3** | 3 | Converting NFA to DFA, regular expressions | A1/3 |  |  |  | A1/3 |  |
| **S4** | 4 | Equivalence of regular expressions and finite automata, closure properties of regular languages | A1/3 |  |  |  | A1/3 |  |
| **S5** | 5 | Pumping lemma for regular languages and proving nonregularity |  |  |  | A1/3 |  |  |
| **S6** | 6 | Context-free languages, pushdown automata model |  | A1/3 |  |  |  |  |
| **S7** | 7 | Context-free grammars, Normal forms, CNF |  | A1/3 |  |  | A1/3 |  |
| **S8** | 8 | Equivalence of CFG and pushdown automata, closure properties of context-free languages |  | A1/3 |  |  | A1/3 |  |
| **S9** | 9 | Pumping Lemma for CFLS, proving non-context-freeness |  | A1/3 |  | A1/3 |  |  |
| **S10** | 10 | Introduction to Turing machines, Church-Turing Thesis |  |  | A1/3 | A1/3 |  |  |
| **S11** | 11 | Variations of TM model, nondeterminism |  |  | A1/3 |  | A1/3 |  |
| **S12** | 12 | Recursive languages vs recursively enumerable languages, computability, Halting problem |  |  | A1/3 | A1/3 |  |  |
| **S13** | 13 | Reductions involving incomputable functions |  |  | A1/3 | A1/3 |  | A1/3 |
| **S14** | 14 | Computability of problems related to regular languages, context-free languagesOverall evaluation of the course |  |  | A1/3 | A1/3 |  | A1/3 |
| **Assessment Methods, Weight in Course Grade, Implementation and Make-Up Rules**  | **No.** | **Type** | **Weight** | **Implementation Rule** | **Make-Up Rule** |
| **A1** | **Exam** | *85* | *There are 2 midterms* *exams and 1 final exam for the course. Each midterm’s weight is 15 and the final exam’s weight is 55. Exam dates will be shown on the tentative schedule and it can be changed according to the course schedule.*  | If a student misses an exam andprovides an acceptable legitimatedocument, a make-up exam will beprovided. |
| **A2** | **Quiz** |  |  |  |
| **A3** | **Homework** | *15* | *There are 3 homework, each with weight 5, for the course. Each student**should prepare his/her homework by himself, herself. Submissions should be neatly presented.* | There will be no make-up for thehomework. |
| **A4** | **Project** |  |  |  |
| **A5** | **Report** |  | - | - |
| **A6** | **Presentation** |  | - | - |
| **A7** | **Attendance/ Interaction** |  | - | - |
| **A8** | **Class/Lab./****Field Work** |  | - | - |
| **A9** | **Other** |  |  |  |
| **TOTAL** | **100%** |
| **Evidence of Achievement of Learning Outcomes** | Students will demonstrate learning outcomes through midterm exam, homework assignments, and the final exam. Every topic is tested with at least one exam or homework question. In order to pass, a student needs to accumulate certain percentage of points and this percentage is determined by the class mean.  |
| **Method for Determining Letter Grade** | The method on which the letter grade is based on will be announced at the beginning of the semester, andthis method may be subjected to change depending on the performance of the students. 2 midterms, 2homework assignments, and the final exam are used for grading. Letter grades are tentatively determinedusing the table below. Here “-x” means (average-3-x) and “+x” means (average+3+x), and each denotesthe minimum points necessary for the corresponding letter grade.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Total points** | +25 | +20 | +15 | +10 | +5 |  Class Average ± 3 | -5 | -10 | -15 | -20 |
| **Letter Grade** | A | A- | B+ | B | B- | C+ | C | C- | D+ | D |

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| **Teaching Methods, Student Work Load** | **No** | **Method** | **Explanation** | **Hours** |
| ***Time applied by instructor*** |
| **1** | **Lecture** | Lecturing and utilizing white board. Sample questions and answers to strengthen learning. In class exams. |  3x14=42 |
| **2** | **Interactive Lecture** |  |  |
| **3** | **Recitation** |  |  |
| **4** | **Laboratory** |  |  |
| **5** | **Practical** |  |  |
| **6** | **Field Work** |  |  |
| ***Time expected to be allocated by student*** |
| **7** | **Project** |  |  |
| **8** | **Homework** | Answers of given questions are prepared at home | 3x8=24 |
| **9** | **Pre-class Learning of Course Material**  | New subjects are learned by reading course materials before class. | 5x14=70 |
| **10** | **Review of Course Material** | Review of the subjects before exams in order to prepare. | 30 |
| **11** | **Studio** |  |  |
| **12** | **Office Hour** | One office hour per week is allocated for students’ questions | 14 |
| **TOTAL** | 180 |
| **IV. PART** |
| **Instructor** | **Name** | Cesim Erten |
| **E-mail** | cesim.erten@antalya.edu.tr |
| **Phone Number** | *+90-242-2450000* |
| **Office Number** | *A1-28* |
| **Office Hours** | *TBA* |
| **Course Materials** | **Mandatory** | *Introduction to the Theory of Computation, Michael Sipser, any edition.* |
| **Recommended** | *Introduction to Automata Theory, Languages, and Computation, J.* *Hopcroft, R. Motwani, J. Ullman, any edition.*  |
| **Other** | **Scholastic Honesty** | Violations of scholastic honesty include, but are not limited to cheating, plagiarizing,fabricating information or citations, facilitating acts of dishonesty by others, havingunauthorized possession of examinations, submitting work of another person or workpreviously used without informing the instructor, or tampering with the academic workof other students. Any for of scholastic dishonesty is a serious academic violation andwill result in a disciplinary action. |
| **Students with Disabilities** | Reasonable accommodations will be made for students with verifiable disabilities. |
| **Safety Issues**  |  |
| **Flexibility** | Circumstances may arise during the course that prevents the instructor from fulfillingeach and every component of this syllabus; therefore, the syllabus is subject to change.Students will be notified prior to any changes. |