University/Academy: Arab Academy for Science and Technology & Maritime Transport
Faculty/Institute: College of Computing and Information Technology
Program: Computer Science / Software Engineering / Information Systems

Form No. (12)
Course Specification

1- Course Data

Course Code:	Course Title:	Academic Year/Level:
CS311	Theory of Computation	Year 3 / Semester 5
Specialization:	**No. of Instructional Units:**	**Lecture:**
Computer Science	2 hrs lecture 2 hrs lab	

2- Course Aim	This course introduces the fundamental mathematical models of computation. The course presents both inherent capabilities and limitations of these computational models as well as their relationships with formal languages. Topics to be covered include: Finite automata and regular languages, deterministic and nondeterministic computations, pumping lemma for regular languages, context-free grammars and languages, pushdown automata, pumping lemma for context-free languages, and Turing machines and their variants.
3- Intended Learning Outcome:	
a- Knowledge and Understanding	**Students will be able to demonstrate knowledge of:** K13. Use high-level programming languages K15. Interpret and analyzing data qualitatively and/or quantitatively. • Define automata, computability theory, and complexity theory. • Understand different methods of proof and essential mathematical background. • Define and describe finite state automata. • Understand how to describe languages using finite automata. • Define and describe non-determinism. • Understand how to describe languages using non-deterministic finite automata. • Understand what regular expressions are. • Understand how to describe languages using regular expressions. • Understand the pigeonhole principle and the pumping lemma. • Understand how to describe languages using regular context-free grammars. • Define and describe push-down automata. • Understand how to describe languages using push-down automata.

	• Understand the relation between regular languages and context-free languages. • Understand how to apply the pumping lemma on non-context-free languages. • Understand how to use Turing machines to represent computable functions. • How a Universal Turing machine can simulate any Turing Machine on any input. • Understand what time and space complexity is. • Describe different problem classes.
b- Intellectual Skills	**By the end of the course, the student acquires high skills and an ability to understand:** I15. Restrict solution methodologies upon their results. I16. Establish criteria, and verify solutions. I17. Identify a range of solutions and critically evaluate and justify proposed design solutions. • Appreciate the limitations of computational models. • Differentiate between determinism and non-determinism. • Appreciate the limitations of computational models. • Give examples of regular languages. • Appreciate the limitations of computational models. • Create proofs for statements regarding formal computational models. • Appreciate the limitations of computational models. • Appreciate the limitations of computational models. • Create proofs for statements regarding formal computational models. • Appreciate the limitations of computational models. • Comprehend the limitations of computers in terms of the problems they can solve. • Comprehend the limitations of computers in terms of the problems they can solve.

c- Professional Skills	**By the end of the course the student will have the ability to:** P14. Specify, design, and implement computer-based systems. P19. Deploy effectively the tools used for the construction and documentation of software, with particular emphasis on understanding the whole process involved in using computers to solve practical problems. • Construct finite automata to describe languages. • Construct nondeterministic automata to describe languages. • Formulate regular expression that generates a given regular language. • Convert regular expressions into finite automata. • Convert finite automata into regular expressions. • Find a context-free grammar for a context-free language. • Find a parse tree, leftmost derivation and rightmost derivation for a word in a context free language. • Show that a context free grammar is ambiguous.

	• Construct push-down automata to describe languages. • Construct Turing Machines to describe languages.
d- General Skills	**Students will be able to:** G1. Demonstrate the ability to make use of a range of learning resources and to manage one's own learning. G3. Show the use of information-retrieval. G7. Show the use of general computing facilities.
4- Course Content	• Introduction • Deterministic Finite State Automata • Non-Deterministic Finite State Automata • Regular Expressions • Non-Regular Languages • Context-Free Grammars • Push-Down Automata • Non-Context Free Languages • Turing Machines • Complexity Theory
5- Teaching and Learning Methods	Lectures, Labs, Projects, Individual study & self-learning.
6- Teaching and Learning Methods for Students with Special Needs	• Students with special needs are requested to contact the college representative for special needs (currently Dr Hoda Mamdouh in room C504) • Consulting with lecturer during office hours. • Consulting with teaching assistant during office hours. • Private Sessions for redelivering the lecture contents. • For handicapped accessibility, please refer to program specification.
7- Student Assessment:	
a- Procedures used:	Exams and Individual Projects
b- Schedule:	7^{th} week exam 30% 12^{th} week exam 20% Lab 10% Final exam 40%

c- Weighing of Assessment:	**Week 7 Grades – 30%** **Week 12 -Grades – 20%** Lab 10% **Week 16 - Final Exam – 40%**

8- List of References:	
a- Course Notes	From the Moodle on www.aast.edu
b- Required Books (Textbooks)	**Michael Sipser,*Introduction to the Theory of Computation*, 2ndedition, Cengage, 2006**
c- Recommended Books	John E. Hopcroft, Rajeev Motwani, and Jeffrey D. Ullman, *Introduction to automata theory, languages, and computation*, 3rd Edition, Addison-Wesley, 2006.
d- Periodicals, Web Sites, ..., etc.	

Course Instructor: **Head of Department:**

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