BITS PILANI, DUBAI CAMPUS

ACADEMIC - UNDERGRADUATE STUDIES DIVISION

FIRST SEMESTER 2023 – 2024

Course Handout (Part – II)

Date: 28.08.2023

In addition to part-I (General Handout for all courses appended to the time table) this portion gives further specific details regarding the course.

Course No. : **CS F351 (3 0 3)**
Course Title : **Theory of Computation**
Instructor-in-charge : **Dr. Elakkiya R**
Instructors : **Dr. Elakkiya R & Dr S. Jeyalatha**

Scope and Objective of the Course:

Theory of Computation course covers basis concepts of formal models of computation and computability. It introduces a hierarchy of machines and languages to capture classes of computable sets. It concludes with a generic notion of computability, and classes of complexity of computable functions. To introduce the notions of automata, formal languages, computability and complexity classes.

Note: Students should complete the prerequisite courses.

Text Book(s) [T]

- **T1:** Harry Lewis, Christios Papadimitriou, Elements of the Theory of Computation, Pearson Education, Second Edition, 2015

Reference Book(s) [R]

- R1: Dexter C Kozen, Automata and Computability, Springer, 2007.
- R2: John Hopcroft, Rajeev Motwani, and Jeffery Ullman, Introduction to Automata Theory, Languages and Computation, Pearson Education, Second Edition, 2001.
- R3: Michael Sipser, Introduction to Theory of Computation, Third Edition, Cengage, 2012.

Bulletin Description: *Given in the Bulletin 2023– 2024*

Course Pre-Requisites :

CS F222-Discrete Structures in Computer Science
CS F214-Logic in Computer Science

Course Plan / Schedule:

Lecture No	Learning Objectives	Topics to be covered	Chapter in the TextBook
1-6	To Understand basis concepts and notation to be used.	Introduction; Infinite sets, Proofs; Closures; Alphabets, Languages & Representation	1.1 – 1.8
7-14	To Understand Finite Automata as recognizers of languages and regular expressions as specifier of Languages.	Deterministic Finite Automata, Non-Deterministic Finite Automata, Closure Properties & Equivalences, Regularity.	2.1 – 2.4 R2: Chapter 2, 3
15-26	To Understand context free grammars as specifiers and push-down automata as recognizers of languages	Context-Free Grammars, Parse Trees & Ambiguity, Push – Down Automata, Equivalence of PDA and CFG, Properties of Context-Free Languages, Parsing, DCFG, Top-Down & Bottom-Up Parsing	3.1 – 3.5, 3.7 R2: Chp 5, 6.
27-36	To Understand Turing Machines as recognizers of	Turing Machines – Introduction, Turing Machines – Notation,	4.1 – 4.5

	languages and as theoretical models of general purpose computers.	Recursive and Recursively enumerable Languages, Extensions of Turing Machines, Random Access Turing Machines, Non-Deterministic Turing Machines	R2: Chp. 8
37-46	To Understand models of computable specification and equivalences and to understand the notion of decidability.	Grammars, Primitive recursive function, Church-Turing Machines, Universal Turing Machines, Halting Problem, Undecidable problem, Properties of recursive Languages	4.6 – 4.7, 5.1 – 5.3, 5.7 R2: Chp. 9
47-56	To Understand the classification of computable problems based on notions of complexity of computation.	The complexity Class P, Satisfiabilty, The Complexity Class NP, NP Completeness, Reducibility	6.1 – 6.4 7.1 – 7.2 R2: Chp.10

*The lectures may be slightly diverging from aforesaid plan based on students' background & interest in the topic, which may perhaps include special lectures and discussions that would be planned and schedule notified according

Course Learning Outcomes:

Upon successful completion of this course, the learner will be able to

- **CLO1:** Develop a foundational grasp of automata theory and formal languages, including their practical implications in computer science contexts.
- **CLO2:** Apply closure properties to various language classes, explore equivalences between different formal models, and evaluate the consequences for language manipulation.
- **CLO3:** Demonstrate skills in creating parse trees, resolving ambiguity in context-free grammars, and utilizing parsing techniques for effective language structure analysis.
- **CLO4:** Analyze Turing machines as abstract computational tools, differentiating solvable problems and exploring the concept of undecidability, particularly in relation to the halting problem.
- **CLO5:** Examine complexity classes P and NP, differentiate their attributes, comprehend polynomial-time reductions, and appreciate NP-completeness' significance in computational complexity theory.

Evaluation scheme:

EC No.	Evaluation Components	Nature of Component	Weightage %	Date – Time & Duration	Venue
1	Quiz 1	Open Book	15	03.10.2023 – T1 30 minutes	To be announced later
2	Midsem Test	Closed Book	30	30.10.23 – AN 90 minutes	
3	Quiz 2	Open Book	15	28.11.2023 – T1 30 minutes	
4	Comprehensive Exam	Closed book	40	02.01.2024 – AN 3 hours	

Mapping of CLOs, PLOs, and CECs

CLOs	PLOs	Evaluation Components (ECs)			
		EC1	EC2	EC3	EC4
CLO1	1, 2, 6	✓	✓		✓
CLO2	2, 6	✓	✓		✓
CLO3	2, 3, 8		✓		✓
CLO4	2, 5,			✓	✓
CLO5	2, 4, 7			✓	✓

Mid-sem Grading:

Mid-sem grading will be displayed after two evaluation components or earlier when- ever about 40% of evaluation components are completed.

Note: A student will be likely to get "NC", if he / she doesn't appear / appear for the sake of appearing for the evaluation components / scoring zero in pre-compre total.

Makeup and Attendance policies:
Make-ups are not given as a routine. It is solely dependent upon the genuineness of the circumstances under which a student fails to appear in a scheduled evaluation component. In such circumstances, prior permission should be obtained from the Instructor-in-Charge (I/C). **Students with less than 50% of attendance will not be allowed to avail the make-ups**. The decision of the I/C in the above matter will be final.

Attendance: Every student is expected to be responsible for regularity of his/her attendance in class rooms and laboratories, to appear in scheduled tests and examinations and fulfill all other tasks assigned to him/her in every course. A student should have a minimum of 60% of attendance in a course to be eligible to appear for the Comprehensive Examination in that course. For the students under the purview of Academic Counseling Board (ACB), the Board shall prescribe the minimum attendance requirement on a case-to-case basis. Attendance in the course will be a deciding factor in judging the seriousness of a student which may be directly / indirectly related to grading.

General timings for consultation:
Chamber consultation hours:
Dr. Elakkiya R: Monday 8th Hour
Dr. Jeyalatha S: Wednesday 3rd Hour

General instructions:
Students should come prepared for classes and carry the text book(s) or material(s) as prescribed by the Course Instructor to the class.
Notices:
All notices concerning the course will be displayed on the CS department Notice Board and on LMS Moodle. Students are also informed to check their BITS email (regularly) for any communication regarding the course.

Dr. Elakkiya R
Instructor-in-Charge

Contact Details:

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