The Hong Kong University of Science and Technology
UG Course Syllabus (Fall 2025-26)

[Course Title] Theory of Computation
[Course Code] COMP 3721
[No. of Credits] 3
[Any pre-/co-requisites] (COMP 3711 OR COMP 3711H) AND (MATH 2111 OR MATH 2121 OR MATH 2131 OR MATH 2350)

Name: Nevin L. Zhang
Email: lzhang@cse.ust.hk

Course Description
This course is an introduction to the foundation of computation. Topics covered include set theory and countability, formal languages, finite automata and regular languages, pushdown automata and context-free languages, Turing machines, undecidability, P and NP, NP completeness.

Required Texts and Materials
Elements of the Theory of Computation, Second Edition, by Harry R. Lewis and Christos H. Papadimitriou, Prentice-Hall International Inc.

[Optional] Additional Resources
- Theory of Computing: A Gentle Introduction, by Efim Kinber, Carl Smith, Prentice Hall.
- Introduction to the Theory of Computation, Second Edition, by Michael Sipser, PWS Publishing Company.
- Introduction to Automata Theory, Languages, and Computation. by John E. Hopcroft and Jeffrey D. Ullman, Addison-Wesley, 2001

Intended Learning Outcomes (ILOs)
By the end of this course, students should be able to:
1. Understand the equivalence of decision problems and language recognition problems and understand the limitations of different classes of computational machine (finite automata, pushdown automata, Turing machine) in recognizing different classes of language.
2. Prove the equivalence of DFA, NFA, regular expressions and the equivalence of PDA and CFG.
3. Design finite automata and write regular expressions for regular languages.
4. Write context-free grammar (CFG) for context-free languages, especially for expressions occurring in programming languages.
5. Design pushdown automata for context-free languages. Given a context-free grammar, construct a PDA that accepts the language generated by the given grammar.
6. Given a non-deterministic finite automaton (NFA), convert it to a deterministic finite automaton (DFA)
7. Apply pumping theorem to prove that a language is not regular or not context free.
8. Understand the Church-Turing thesis and the unsolvability of the halting problem and apply reduction technique to prove the undecidability of decision problems, in particular language recognition problems.
9. Understand the concepts of P, NP, and NP-completeness and use reductions to prove that a given problem is NP-complete.
10. Understand the concepts of PSPACE, NPSPACE, NPSPACE-complete, and EXPTIME, and their relationships.

Assessment and Grading

This course will be assessed using criterion-referencing and grades will not be assigned using a curve. Detailed rubrics for each assignment are provided below, outlining the criteria used for evaluation.

Assessment Task	Contribution to Overall Course grade (%)
Homework Assignments	20%
Midterm examination	30%
Final examination	50%

Assessments:

[List specific assessed tasks, exams, quizzes, their weightage, and due dates; perhaps, add a summary table as below, to precede the details for each assessment.]

Assessment Task	Contribution to Overall Course grade (%)	Due date (Tentative)
4 Homework Assignments	20%	Assignment 1: 29/09/2025 Assignment 2: 17/10/2025 Assignment 3: 07/11/2025 Assignment 4: 28/11/2024
Mid-Term	30%	20/10/2025
Final examination	50%	?/12/2025

* Assessment marks for individual assessed tasks will be released within two weeks of the due date.

Mapping of Course ILOs to Assessment Tasks

[add to/delete table as appropriate]

Assessed Task	Mapped ILOs	Explanation
Homework Assignment 1	ILO2, ILO3, ILO4	This assignment assesses students' understanding of DFA, NFA and regular expressions (RE), and their equivalence.
Homework Assignment 2	ILO1, ILO5, ILO6, ILO7	This assignment assesses students' understanding of CFG and Pushdown automata (PA), and their equivalence. It also tests students' understanding of the limitations of DFA/NFA/regular expressions and CFG and PA in representing formal languages.
Midterm Examination	ILO1, ILO2, ILO3, ILO4, ILO5, ILO6, ILO7	The midterm tests students' understanding of DFA, NFA, RE, CFG and PA, as well as the equivalence of decision problems and language recognition problems. It also assesses student's ability to prove relationships among them and their liminations.
Homework Assignment 3	ILO8	This assignment assesses students' understanding of Turing Machines (TMs) and two different ways of using TMs to recognize formal languages (recursive languages and recursive enumerable languages). It also tests students' ability to give unsolvability proofs.
Homework Assignment 4	ILO9, ILO10	This assignment assesses students' understanding of common complexity classes, including P, NP, NPC, PSPCE, NPSPACE, NPSPACE-complete, and EXPTIME, and their relationships.

Final Examination	IL01- IL10	The final examination assesses the students' understanding of the entire course, with an emphasis on IL8-IL10, which cover various complexity classes and their ability of prove relationships among them.

Grading Rubrics
All the homework and exam questions are mathematical in nature. An answer can either be correct or incorrect. The correct answers for some of the questions consist of multiple steps. Each step is graded separately whenever possible.

Final Grade Descriptors:
[As appropriate to the course and aligned with university standards]

Grades	Short Description	Elaboration on subject grading description
A	Excellent Performance	Total score 85/100 or above
B	Good Performance	Total score 65/100 - 84/100
C	Satisfactory Performance	Total score 45/100 - 64/100
D	Marginal Pass	
F	Fail	Total score below 45/100

Note: Most students in this class are CSE PhD students. They need a B grade to pass.

Course AI Policy
[State the course policy on the use of generative artificial intelligence tools to complete assessment tasks.]
The midterm and final are closed-book exams. There are no restrictions on the use of generative AI for homework assignments. The homework assignments account for a small percentage of the total grades. The students are reminded multiple times that you would suffer in the examinations if you don't work on the homework assignments independently.

Communication and Feedback
Assessment marks for individual assessed tasks are communicated via Canvas within two weeks of submission. Feedback on assignments includes why marks are deducted and model solutions are also provided for the students to compare their answers with. Students who have further questions about the feedback including marks should consult the instructor within five working days after the feedback is received.

Resubmission Policy
[If applicable, explain the policy for resubmitting work or reassessment opportunities, including conditions and deadlines.]
Resubmissions are not allowed.

Required Texts and Materials
Elements of the Theory of Computation, Second Edition, by Harry R. Lewis and Christos H. Papadimitriou, Prentice-Hall International Inc.

Academic Integrity
Students are expected to adhere to the university's academic integrity policy. Students are expected to uphold HKUST's Academic Honor Code and to maintain the highest standards of academic integrity. The University has zero tolerance of academic misconduct. Please refer to Academic Integrity | HKUST – Academic Registry for the University's definition of plagiarism and ways to avoid cheating and plagiarism.

Additional Resources
Online course content to be published in HKUST canvas when the semester begins.