

Subject Description Form

Subject Code	COMP4011					
Subject Title	Theory of Computation					
Credit Value	3					
Level	4					
Pre-requisite / Co-requisite / Exclusion	Pre-requisite: COMP3011					
Objectives	<p>The objectives of this subject are to:</p> <ol style="list-style-type: none"> 1. provide students with concepts in theory of computation; and 2. develop students' ability for comprehending mathematical proofs (in theory of computation). 					
Intended Learning Outcomes	<p>Upon completion of the subject, students will be able to:</p> <p><i>Professional/academic knowledge and skills</i></p> <ol style="list-style-type: none"> (a) analyse and design automata and Turing machines; (b) prove results in theory of computation; (c) demonstrate in-depth understanding of computability, decidability, and complexity; <p><i>Attributes for all-roundedness</i></p> <ol style="list-style-type: none"> (d) solve problems independently; and (e) think critically for improvement in solutions. 					
Subject Synopsis/ Indicative Syllabus	<table border="1" style="width: 100%;"> <thead> <tr> <th style="text-align: left;">Topic</th> </tr> </thead> <tbody> <tr> <td> 1. Automata Finite automata (DFA, NFA). </td> </tr> <tr> <td> 2. Regular Expressions and Languages Regular expressions, conversion between DFA and regular expressions, properties of regular languages. </td> </tr> <tr> <td> 3. Context-free Grammars and Languages Context-free grammars, parse trees, ambiguity in grammars, normal forms, Chomsky hierarchy. </td> </tr> <tr> <td> 4. Pushdown Automata Pushdown automata (PDA), pumping lemma, properties of PDA. </td> </tr> </tbody> </table>	Topic	1. Automata Finite automata (DFA, NFA).	2. Regular Expressions and Languages Regular expressions, conversion between DFA and regular expressions, properties of regular languages.	3. Context-free Grammars and Languages Context-free grammars, parse trees, ambiguity in grammars, normal forms, Chomsky hierarchy.	4. Pushdown Automata Pushdown automata (PDA), pumping lemma, properties of PDA.
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	<p>5. Turing Machines Turing machines (TM), extensions to TM, relation to computers.</p> <p>6. Computability and Decidability Computability, Church-Turing thesis, the halting problem, other undecidable problems, technique of reduction.</p> <p>7. Intractable Problems The classes P and NP, NP-completeness.</p> <p>8. Advanced Topics and Applications Polynomial-space Turing machines, randomised Turing machines, primality testing, cryptography, game theory, quantum computing.</p>																																																	
<p>Teaching/ Learning Methodology</p>	<p>Lectures provide students the main concepts of the topic, together with comprehensive examples for easy understanding.</p> <p>Tutorial sessions offer an opportunity to students for practicing their techniques.</p> <p>Assignments help students develop their design and analysis skills.</p>																																																	
<p>Assessment Methods in Alignment with Intended Learning Outcomes</p>	<table border="1"> <thead> <tr> <th rowspan="2">Specific assessment methods/tasks</th> <th rowspan="2">% weighting</th> <th colspan="5">Intended subject learning outcomes to be assessed</th> </tr> <tr> <th>a</th> <th>b</th> <th>c</th> <th>d</th> <th>e</th> </tr> </thead> <tbody> <tr> <td>Continuous Assessment</td> <td rowspan="3">30%</td> <td colspan="5"></td> </tr> <tr> <td>1. Assignments</td> <td>✓</td> <td>✓</td> <td>✓</td> <td>✓</td> <td>✓</td> </tr> <tr> <td>2. Mid-Term / Tests</td> <td>✓</td> <td>✓</td> <td>✓</td> <td>✓</td> <td>✓</td> </tr> <tr> <td>Examination</td> <td>70%</td> <td>✓</td> <td>✓</td> <td>✓</td> <td>✓</td> <td>✓</td> </tr> <tr> <td>Total</td> <td>100%</td> <td colspan="5"></td> </tr> </tbody> </table> <p>Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:</p> <p>All assignments, mid-term/test, and examination are used to test students' understanding of the subject materials.</p>					Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed					a	b	c	d	e	Continuous Assessment	30%						1. Assignments	✓	✓	✓	✓	✓	2. Mid-Term / Tests	✓	✓	✓	✓	✓	Examination	70%	✓	✓	✓	✓	✓	Total	100%					
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Student Study Effort Expected	Class contact:	
	▪ Lecture	26 Hrs.
	▪ Tutorial	13 Hrs.
	Other student study effort:	
	▪ Reading Book Chapters, Assignments	66 Hrs.
	Total student study effort	105 Hrs.
Reading List and References	Reference Book: 1. Hopcroft, John E., Motwani, Rajeev, Ullman, Jeffrey D., <i>Introduction to Automata Theory, Languages, and Computation</i> , 3 rd Edition, Pearson, ISBN 1292039051, 2013.	