

## Subject Description Form

<b>Subject Code</b>	COMP4011					
<b>Subject Title</b>	Theory of Computation					
<b>Credit Value</b>	3					
<b>Level</b>	4					
<b>Pre-requisite / Co-requisite / Exclusion</b>	<b>Pre-requisite:</b> COMP3011					
<b>Objectives</b>	<p>The objectives of this subject are to:</p> <ol style="list-style-type: none"> <li>1. provide students with concepts in theory of computation; and</li> <li>2. develop students' ability for comprehending mathematical proofs (in theory of computation).</li> </ol>					
<b>Intended Learning Outcomes</b>	<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"> <li>(a) analyse and design automata and Turing machines;</li> <li>(b) prove results in theory of computation;</li> <li>(c) demonstrate in-depth understanding of computability, decidability, and complexity;</li> </ol> <p><i>Attributes for all-roundedness</i></p> <ol style="list-style-type: none"> <li>(d) solve problems independently; and</li> <li>(e) think critically for improvement in solutions.</li> </ol>					
<b>Subject Synopsis/ Indicative Syllabus</b>	<table border="1" style="width: 100%;"> <thead> <tr> <th style="text-align: left;">Topic</th> </tr> </thead> <tbody> <tr> <td> <b>1. Automata</b>            Finite automata (DFA, NFA).         </td> </tr> <tr> <td> <b>2. Regular Expressions and Languages</b>            Regular expressions, conversion between DFA and regular expressions, properties of regular languages.         </td> </tr> <tr> <td> <b>3. Context-free Grammars and Languages</b>            Context-free grammars, parse trees, ambiguity in grammars, normal forms, Chomsky hierarchy.         </td> </tr> <tr> <td> <b>4. Pushdown Automata</b>            Pushdown automata (PDA), pumping lemma, properties of PDA.         </td> </tr> </tbody> </table>	Topic	<b>1. Automata</b> Finite automata (DFA, NFA).	<b>2. Regular Expressions and Languages</b> Regular expressions, conversion between DFA and regular expressions, properties of regular languages.	<b>3. Context-free Grammars and Languages</b> Context-free grammars, parse trees, ambiguity in grammars, normal forms, Chomsky hierarchy.	<b>4. Pushdown Automata</b> Pushdown automata (PDA), pumping lemma, properties of PDA.
Topic						
<b>1. Automata</b> Finite automata (DFA, NFA).						
<b>2. Regular Expressions and Languages</b> Regular expressions, conversion between DFA and regular expressions, properties of regular languages.						
<b>3. Context-free Grammars and Languages</b> Context-free grammars, parse trees, ambiguity in grammars, normal forms, Chomsky hierarchy.						
<b>4. Pushdown Automata</b> Pushdown automata (PDA), pumping lemma, properties of PDA.						

	<p><b>5. Turing Machines</b> Turing machines (TM), extensions to TM, relation to computers.</p> <p><b>6. Computability and Decidability</b> Computability, Church-Turing thesis, the halting problem, other undecidable problems, technique of reduction.</p> <p><b>7. Intractable Problems</b> The classes P and NP, NP-completeness.</p> <p><b>8. Advanced Topics and Applications</b> Polynomial-space Turing machines, randomised Turing machines, primality testing, cryptography, game theory, quantum computing.</p>																																											
<p><b>Teaching/ Learning Methodology</b></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><b>Assessment Methods in Alignment with Intended Learning Outcomes</b></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><b>Continuous Assessment</b></td> <td rowspan="2"><b>60%</b></td> <td colspan="5"></td> </tr> <tr> <td>1. Assignments</td> <td>✓</td> <td>✓</td> <td>✓</td> <td>✓</td> <td>✓</td> </tr> <tr> <td><b>Examination</b></td> <td><b>40%</b></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>Both assignments 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	<b>Continuous Assessment</b>	<b>60%</b>						1. Assignments	✓	✓	✓	✓	✓	<b>Examination</b>	<b>40%</b>	✓	✓	✓	✓	✓	Total	100%					
Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed																																										
		a	b	c	d	e																																						
<b>Continuous Assessment</b>	<b>60%</b>																																											
1. Assignments		✓	✓	✓	✓	✓																																						
<b>Examination</b>	<b>40%</b>	✓	✓	✓	✓	✓																																						
Total	100%																																											
<p><b>Student Study Effort Expected</b></p>	<p>Class contact:</p> <table border="1"> <tr> <td>▪ Lecture</td> <td>26 Hrs.</td> </tr> <tr> <td>▪ Tutorial</td> <td>13 Hrs.</td> </tr> </table> <p>Other student study effort:</p> <table border="1"> <tr> <td>▪ Reading Book Chapters, Assignments</td> <td>66 Hrs.</td> </tr> <tr> <td>Total student study effort</td> <td>105 Hrs.</td> </tr> </table>					▪ Lecture	26 Hrs.	▪ Tutorial	13 Hrs.	▪ Reading Book Chapters, Assignments	66 Hrs.	Total student study effort	105 Hrs.																															
▪ Lecture	26 Hrs.																																											
▪ Tutorial	13 Hrs.																																											
▪ 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., *Introduction to Automata Theory, Languages, and Computation*, 3<sup>rd</sup> Edition, Pearson, ISBN 1292039051, 2013.