

Course No.	Course Name	L-T-P -Credits	Year of Introduction
CS367	Logic for Computer Science	3-0-0-3	2015
<b>Pre-requisites</b> <ol style="list-style-type: none"><li>1. <b>BE101-05</b> Introduction to Computing and Problem Solving</li><li>2. <b>CS205</b> Data Structures</li></ol>			
<b>Course Objectives</b> <ol style="list-style-type: none"><li>1. <i>To introduce the concepts of mathematical logic and its importance.</i></li><li>2. <i>To discuss propositional, predicate, temporal and modal logic and their applications.</i></li></ol>			
<b>Syllabus</b> <p>Propositional Logic, Resolution, binary decision diagrams, Predicate logic, resolution, temporal logic, deduction, program verification, modal logic.</p>			
<b>Expected Outcome</b> <p>Student is able to</p> <ol style="list-style-type: none"><li>1. <i>Explain the concept of logic and its importance.</i></li><li>2. <i>Understand fundamental concepts in propositional logic and apply resolution techniques.</i></li><li>3. <i>Understand fundamental concepts in predicate logic and apply resolution techniques.</i></li><li>4. <i>Understand fundamental concepts in temporal logic and apply resolution techniques.</i></li><li>5. <i>Understand the concept of program verification and apply it in real-world scenarios.</i></li><li>6. <i>Understand fundamental concepts in modal logic.</i></li></ol>			
<b>Text Books</b> <ol style="list-style-type: none"><li>1. Modechai Ben-Ari, Mathematical Logic for Computer Science, Springer, 3/e, 2102.</li><li>2. Arindhama Singh, Logics for Computer Science, Prentice Hall India, 2004.</li></ol>			
<b>Reference</b> <ol style="list-style-type: none"><li>1. Michael Huth, Mark Ryan, Logic in Computer Science: Modeling and Reasoning about Systems, Cambridge University Press, 2005.</li></ol>			

Course Plan			
Module	Contents	Hours	Sem. Exam Marks %
I	<p>Introductory Concepts: Mathematical Logic, Propositional Logic, First Order Logic, Modal and Temporal logic, Program Verification.</p> <p><b>(Reading: Ben-Ari, Chapter 1)</b></p> <p>Propositional Logic: Formulae and interpretations, Equivalence, Satisfiability &amp; Validity, Semantic Tableaux, Soundness and Completeness.</p> <p><b>(Reading: Ben-Ari, Chapter 2 except 2.4, Additional Reading : Singh, Chapter 1)</b></p>	06	15%
II	<p>The Hilbert Deductive System, Derived Rules, Theorems and operators, Soundness and Completeness, Consistency.</p> <p><b>(Reading: Ben-Ari, Chapter 3 except 3.7 and 3.8, Additional Reading : Singh, Chapter 1)</b></p> <p>Resolution in Propositional Logic: Conjunctive Normal form, Clausal form, resolution rule.</p> <p><b>(Reading: Ben-Ari, Chapter 4.1, 4.2, 4.3, Additional Reading : Singh, Chapter 1)</b></p>	06	15%
FIRST INTERNAL EXAM			
III	<p>Binary Decision Diagrams: Definition, Reduced and ordered BDD, Operators.</p> <p><b>(Reading: Ben-Ari, Chapter 5.1 - 5.5)</b></p> <p>Predicate Logic: Relations, predicates, formulae and interpretation, logical equivalence, semantic tableaux, soundness.</p> <p><b>Reading: Ben-Ari, Chapter 7.1-7.6, Additional Reading : Singh, Chapter 2)</b></p>	07	15%
IV	<p>The Hilbert deduction system for predicate logic. Functions, PCNF and clausal form, Herbrand</p>	08	15%

	model.Resolution in predicate logic: ground resolution, substitution, unification, general resolution. <b>Reading: Ben-Ari, Chapter 8.1-8.4, 9.1, 9.3, 10.1-10.4, Additional Reading : Singh, Chapter 2, Chapter 3)</b>		
<b>SECOND INTERNAL EXAM</b>			
<b>V</b>	Temporal logic: Syntax and semantics, models of time, linear time temporal logic, semantic tableaux. Deduction system of temporal logic. <b>(Reading: Ben-Ari, Chapter 13.1-13.5, 14.1-14.2)</b>	<b>07</b>	<b>20%</b>
<b>VI</b>	Program Verification: Need for verification, Framework for verification, Verification of sequential programs, deductive system, verification, synthesis. <b>(Reading: Ben-Ari, Chapter 15.1-15.4, Additional Reading : Singh, Chapter 5)</b> <b>Modal Logic:</b> Need for modal logic, Case Study: Syntax and Semantics of K, Axiomatic System KC, <b>(Reading: Singh, Chapter 6.1-6.3)</b>	<b>08</b>	<b>20%</b>
<b>END SEMESTER EXAM</b>			

### Assignments

Some of the assignments can be given on an interactive theorem prover like Isabelle or Coq.

### Question Paper Pattern

- There will be *five* parts in the question paper – A, B, C, D, E
- Part A
  - Total marks : 12
  - Four* questions each having 3 marks, uniformly covering modules I and II;  
All*four* questions have to be answered.
- Part B
  - Total marks : 18

- b. Three questions each having 9 marks, uniformly covering modules I and II; Two questions have to be answered. Each question can have a maximum of three subparts.
- 4. Part C
  - a. Total marks : 12
  - b. Four questions each having 3 marks, uniformly covering modules III and IV; Allfour questions have to be answered.
- 5. Part D
  - a. Total marks : 18
  - b. Three questions each having 9 marks, uniformly covering modules III and IV; Two questions have to be answered. Each question can have a maximum of three subparts
- 6. Part E
  - a. Total Marks: 40
  - b. Six questions each carrying 10 marks, uniformly covering modules V and VI; four questions have to be answered.
  - c. A question can have a maximum of three sub-parts.
- 7. There should be at least 60% analytical/numerical questions.