Course No.	Course Name	L-T-P -Credits	Year of Introduction
CS367	Logic for Computer Science	3-0-0-3	2015

Pre-requisites

1. **BE101-05** Introduction to Computing and Problem Solving
2. **CS205** Data Structures

Course Objectives

1. *To introduce the concepts of mathematical logic and its importance.*
2. *To discuss propositional, predicate, temporal and modal logic and their applications.*

Syllabus

Propositional Logic, Resolution, binary decision diagrams, Predicate logic, resolution, temporal logic, deduction, program verification, modal logic.

Expected Outcome

Student is able to

1. *Explain the concept of logic and its importance.*
2. *Understand fundamental concepts in propositional logic and apply resolution techniques.*
3. *Understand fundamental concepts in predicate logic and apply resolution techniques.*
4. *Understand fundamental concepts in temporal logic and apply resolution techniques.*
5. *Understand the concept of program verification and apply it in real-world scenarios.*
6. *Understand fundamental concepts in modal logic.*

Text Books

1. Modechai Ben-Ari, Mathematical Logic for Computer Science, Springer, 3/e, 2102.
2. Arindhama Singh, Logics for Computer Science, Prentice Hall India, 2004.

Reference

1. Michael Huth, Mark Ryan, Logic in Computer Science: Modeling and Reasoning about Systems, Cambridge University Press, 2005.

Course Plan			
Module	Contents	**Hours**	**Sem. Exam Marks %**
I	Introductory Concepts: Mathematical Logic, Propositional Logic, First Order Logic, Modal and Temporal logic, Program Verification. (**Reading: Ben-Ari, Chapter 1**) Propositional Logic: Formulae and interpretations, Equivalence, Satisfiability& Validity, Semantic Tableaux, Soundness and Completeness. (**Reading: Ben-Ari, Chapter 2 except 2.4, Additional Reading : Singh, Chapter 1**)	**06**	**15%**
II	The Hilbert Deductive System, Derived Rules, Theorems and operators, Soundness and Completeness, Consistency. (**Reading: Ben-Ari, Chapter 3 except 3.7 and 3.8, Additional Reading : Singh, Chapter 1**) Resolution in Propositional Logic: Conjunctive Normal form, Clausal form, resolution rule. (**Reading: Ben-Ari, Chapter 4.1, 4,2, 4.3, Additional Reading : Singh, Chapter 1**)	**06**	**15%**
FIRST INTERNAL EXAM			
III	Binary Decision Diagrams: Definition, Reduced and ordered BDD, Operators. **(Reading: Ben-Ari, Chapter 5.1 – 5.5**) Predicate Logic: Relations, predicates, formulae and interpretation, logical equivalence, semantic tableaux, soundness. **Reading: Ben-Ari, Chapter 7.1-7.6, Additional Reading : Singh, Chapter 2**)	**07**	**15%**
IV	The Hilbert deduction system for predicate logic.Functions, PCNF and clausal form, Herbrand	**08**	**15%**

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

Assignments

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

Question Paper Pattern

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