COURSE DESCRIPTION – ACADEMIC YEAR 2017/2018

Course title	**Advanced Logic**
Course code	74002
Scientific sector	INF/01
Degree	European Master's Program in Computational Logic (LM-18)
Semester	2
Year	1
Credits	8
Modular	No
University	UniBZ

Total lecturing hours	48
Total lab hours	24
Total exercise hours	--
Attendance	Not compulsory
Prerequisites	Basics of Propositional Logic and First-Order Logic.
Course page	https://ole.unibz.it/

Specific educational objectives	The course belongs to the type "caratterizzanti – discipline informatiche". The course belongs to the mandatory part of the study program and its credits must be acquired by all the students. The aim of this course is to introduce basic concepts beyond first-order predicate logics. In Computer Science many different logics and deductive systems exist. Specific families of logics aimed at different application areas are introduced: logics of time and computation (modal logics, temporal Logics), logics for reasoning about knowledge (epistemic logic). In this course students will develop a deeper understanding of some of the logics beyond first order logic. Students will be introduced to different Modal Logics and they will be able to apply them to different area of Computer Science. In particular, they will appreciate the use of logics for the specification and verification of hardware systems, and they will learn how to use Model Checking to verify properties of systems.

Lecturer	Rafael Penaloza Nyssen
Contact	Piazza Domenicani 3, Room 3.04, Rafael.Penaloza@unibz.it, 0471-016145
Scientific sector of lecturer	INF/01
Teaching language	English
Office hours	During the lecture time span: Wednesday 16:00 -- 18:00, arrange by email with lecturer.
Lecturing Assistant (if any)	--
Contact LA	--
Office hours LA	--
List of topics	Foundations of Modal Logic: • Modal languages, examples and variants (e.g., propositional • dynamic logic, logic of knowledge etc.) • Kripke Structures and Semantics of modal logics • Basic model construction techniques, e.g., disjoint unions and generated submodels that preserve modal satisfiability

	• Bisimulations and techniques to show inexpressibility of modalities • Calculi for modal logics Temporal Logics and Formal Methods: • Modeling Systems as Transition Systems • Linear Temporal Logic (LTL) • Computation Tree Logic (CTL and CTL*) • Model Checking CTL formulas • CTL Symbolic Model Checking • LTL Symbolic Model Checking • Software for formal verification NuSMV
Teaching format	Frontal Lectures, Exercise, Project.

Learning outcomes	Knowledge and understanding • Knowledge of symbolic model checking techniques • Knowledge of formal methods techniques and their use to analyse properties of complex systems • Understand methods of mathematics that support Information Technology and its applications. Applying knowledge and understanding • Ability to formalise in an original way using appropriate mathematical tools complex problems formulated using natural language • Be able to extend or modify a formal calculation model in an original way, taking into account altered conditions or requirements Making judgements • Be able to independently select the documentation required to keep abreast of the frequent technological innovations in the field by using a wide variety of documentary sources: books, web, magazines. • Be able to plan and re-plan a technical project activity aimed at building an information system and to bring it to completion by meeting the defined deadlines and objectives. Communication skills • Be able to interact and collaborate with peers and experts. Learning skills • Be able to autonomously extend the knowledge acquired during the study course by reading and understanding scientific and technical documentation.

Assessment	The assessment of the course consists of three parts: • Midterm Written Exam • Final Written Exam • Project (system specification and verification using NuSMV)
Assessment language	English
Evaluation criteria and criteria for awarding marks	The exam will assess the understanding of the theory of modal logic and model checking. The project will assess the capacity of students to model systems and verify their properties with Formal verification approach. The final mark will be formed as follows: • Midterm Written Exam: 45%

	• Final Written Exam: 45% • Project: 10%

Required readings	• Modal Logic, by P. Blackburn, M. de Rijke and Y. Venema, in Cambridge Tracts in Theoretical Computer Science, vol. 53 (available in the FUB library) • Logic in Computer Science--Modelling and Reasoning about Systems. Michael Huth and Mark Ryan. Publisher: Cambridge University Press, 2004.
Supplementary readings	• Model Checking. Edmund Clarke, Orna Grumberg and Doron Peled. Publisher: MIT Press, 1999.