UNIVERSITAS GADJAH MADA

Faculty of Mathematics and Natural Sciences

Department of Computer Science and Electronics

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Doctoral Programme of Computer Science

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Module name	: **F**ORMAL **M**ETHODS
Module level, if applicable	: **D**OCTORAL
Code, if applicable	: MII7225
Semester(s) in which the module is taught	: 1 (Odd)
Person responsible for the module	: Dr.-Ing. Reza Pulungan, M.Sc.
Lecturer(s)	: Dr.-Ing. Reza Pulungan, M.Sc., Dr. Suprapto, M.I.Komp.
Language	: Indonesia
Relation to curriculum	: Doctorate; elective; 1st or 3rd semester.
Credit points	: 3 credits
Type of teaching, contact hours	: Doctorate: lectures for < 5 students. Contact hours are lecture hours.
Workload	: (1) Lectures and discussion: 3 x 50 = 150 minutes (2.5 hours) per week. (2) Exercises and assignments: 3 x 60 = 180 minutes (3 hours) per week. (3) Independent study: 3 x 60 = 180 minutes (3 hours) per week.
Requirements according to the examination regulations	: A student must have attended at least 75% of the lectures to sit in the exams.
Recommended prerequisite	: -
Module objectives/ intended learning outcomes	: This course is a postgraduate level course that discusses basic methods and tools for creating program specifications and how to think about programs with programming logics, including formal logical proof techniques, correct code synthesis, model checking, type-theory, and methods for thinking about concurrent programs. After completing this course, students are expected to: CO1 Analyse research development of a specific field of formal method in a technical manner, especially in formal specification and formal verification.

	CO2 Substantiate the analysis using existing scientific knowledge in the field of formal method and write down the analysis systematically in an essay. CO3 Evaluate a substantiated analyses of others. CO4 Synthesize and create a new research plan in the field of formal method with an adequate novelty.
Content	: Topics covered in this course include: introduction to formal methods; the use of logic to think about programs and processes; meta language (ML): classic ML, event ML, type and type inference in ML; formal logic: introduction, computational logic, atomic evidence, the meaning of computational logic formulas, proofs, logic for quantified statements, computational first-order logic, first-order logic as a programming language; programmable specifications; formalize arithmetic and arithmetic specifications; induction and interaction; program verification; recursion and introduction to event logic; the use of formal methods on security; event theory and event theory on first-order logic; and consensus protocol.
Study and examination requirements and forms of examination	: Evaluation is done in 3 forms, namely: 1. Two examinations, mid-term and final, 2. A modelling assignment, and 3. A short review paper on state-of-the-art methods in formal methods. Assessment is done using benchmark assessment, with the aim of measuring the level of students' understanding related to the target and class rank.
Media employed	: LCD, blackboard, and websites.
Reading List	: 1. Papadimitriou, Computational Complexity, Addison-Wesley, 1994. 2. Baier and Katoen, Principles of Model Checking, MIT Press, 2008. 3. Hoare, An Axiomatic Basis for Computer Programming, Communications of the ACM, 1969. 4. Kreitz and Rahli, Introduction to Classic ML, Cornell University, 2011. 5. Bickford, Constable, Eaton, Guaspari, and Rahli, Introduction to EventML, 2011. 6. Boyer and Moore, Computational Logic Handbook, A Formal Method, Morgan Kaufmann, 1997.

The Mapping of COs to PLOs

COs	PLOs							
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CO1								

CO2								
CO3								
CO4								

The PLO of DP-CS

PLO	Knowledge Area	PLO Description
PLO1	[Values and principles]	A graduate should be devoted to God Almighty, uphold the humanity values, internalize academic values and ethics, responsible in working around expertise independently.
Managerial Capability		
PLO2	[Professional attitudes]	A graduate should have good interpersonal skills; able to work together within the organization, both as a leader and a member; able to be the initiator; able to manage and delegate tasks; and have a sense of responsibility for their own work as well as take responsibility for the achievement of the organization's work.
PLO3	[Communication skills]	A graduate should be able to communicate effectively and efficiently with stakeholders from various backgrounds; use English well; and able to write and present scientific papers correctly and well.
PLO4	[Life-long learning]	A graduate should be up to date with the state-of-the-art especially in computer science field, able to take parts in the development of computer science field that is engaged in and relate it to other fields throughout life.
Working Capability		
PLO5	[Problem-solving and Scientific skills]	A graduate should be able to analyse science and technology problems in the computer science field, develop alternative solutions through intra disciplinary, interdisciplinary, and trans disciplinary approaches to produce innovative, original, and tested works.
PLO6	[Ability to formulate and do research]	A graduate should be able to formulate research problems through critical, exploratory, and innovative studies both independently and in groups of computer science field that is engaged in and present research results in a scientific paper at regional or international level.
Mastering Knowledge		
PLO7	[Fundamental knowledge]	A graduate should be able to develop knowledge in the field of computer science that is engaged, which includes abstraction, complexity, evolution and philosophy of changes or developments in the field of science.
PLO8	[Applied knowledge]	A graduate should be able to develop theoretical, philosophical, and applied concepts in the field of computer

		science that is engaged in, and to represent them in a structured and systematic manner.