SYLLABUS

1. Information regarding the programme

1.1 Higher education institution	**Babeş Bolyai University**
1.2 Faculty	**Faculty of Mathematics and Computer Science**
1.3 Department	**Department of Computer Science**
1.4 Field of study	**Computer Science**
1.5 Study cycle	**Master**
1.6 Study programme / Qualification	**High Performance Computing and Big Data Analytics Profile**

2. Information regarding the discipline

2.1 Name of the discipline	**Resource Aware Computation**						
2.2 Course coordinator	**Assoc. Prof. PhD. Ing. Florin Craciun**						
2.3 Seminar coordinator	**Assoc. Prof. PhD. Ing. Florin Craciun**						
2.4. Year of study	**1**	2.5 Semester	**2**	2.6. Type of evaluation	**E**	2.7 Type of discipline	**compulsory**

3. Total estimated time (hours/semester of didactic activities)

3.1 Hours per week	3	Of which: 3.2 course	2	3.3 seminar/laboratory	1
3.4 Total hours in the curriculum	42	Of which: 3.5 course	28	3.6 seminar/laboratory	14
Time allotment:					hours
Learning using manual, course support, bibliography, course notes					30
Additional documentation (in libraries, on electronic platforms, field documentation)					30
Preparation for seminars/labs, homework, papers, portfolios and essays					70
Tutorship					14
Evaluations					14
Other activities:					-

3.7 Total individual study hours	158
3.8 Total hours per semester	200
3.9 Number of ECTS credits	8

4. Prerequisites (if necessary)

4.1. curriculum	• None
4.2. competencies	• Basic software development skills • Procedural and Object-oriented paradigms

5. Conditions (if necessary)

5.1. for the course	

6. Specific competencies acquired

Professional competencies	• Understanding and working with basic concepts in software engineering; • Knowledge, understanding and use of basic concepts of theoretical Computer Science • Capability of analysis and synthesis; • Proficient use of methodologies and tools specific tool software systems • Good programming skills in high-level languages
Transversal competencies	• Improved programming abilities: debugging and correcting compilers errors • Ability to apply compiler techniques to different real life problems

7. Objectives of the discipline (outcome of the acquired competencies)

7.1 General objective of the discipline	• To understand fundamental concepts of software quality. • To be able to apply basic methods for software analysis and software quality assurance.
7.2 Specific objective of the discipline	• To learn the methods of program verification and validation. • To become used with building correct programs from specifications • To acquire a modern programming style • To understand how the resources(memory, CPU, batery) are used by the programs

8. Content

8.1 Course	Teaching methods	Remarks
1. Semantics of sequential programs. Procedural paradigm. Object-oriented paradigm. Functional paradigm. Operational semantics. Denotational semantics. Small-Steps Semantics. Big-Steps Semantics.	Exposure,description, explanation, debate and dialogue, discussion of case studies	
2. Semantics of concurrent programs. Concurrency models. Processes & threads Atomic actions, interleaving model. Transition systems & diagrams,Safety and liveness.	explanation, debate and dialogue, discussion of case studies	
3. Semantics of concurrent programs. Critical regions, lock protocols. Barriers, Semaphores, Monitors, Deadlocks	Exposure,description, explanation	
4. Semantics of multicore programs. Cell processors. Parallel architectures. Parallel programming concepts.	Exposure,description, explanation	
5. Semantics of multicore programs. Parallel	Exposure,description,	

programming design patterns. StreamIt language. Parallelizing compilers.	explanation, discussion of case studies	
6. Semantics of resources usage in sequential, concurrent and parallel paradigms. Memory usage models.	Exposure,description, explanation, discussion of case studies	
7. Semantics of resources usage in sequential, concurrent and parallel paradigms. Memory usage models. CPU usage models. Battery usage models.	Exposure,description, explanation,	
8. Static analysis. Principles.Dataflow analysis.Type-based analysis	Exposure,description, explanation	
9. Static analysis. Symbolic execution. Abstract interpretation	Exposure,description, explanation, discussion of case studies	
10. Automatic verification. Hoare logic. Separation logic. Modular verification	Exposure,description, explanation, discussion of case studies	
11. Automatic verification. Theory solvers in SMT. Invariant inference	Exposure,description, explanation, discussion of case studies	
12. Analysis and verification of memory usage. Memory models. Shape analysis. Type based methods. Separation logic methods.	Exposure,description, explanation, discussion of case studies	
13. Analysis and verification of cpu usage. Cost analysis. Loop invariants.	Exposure,description, explanation, discussion of case studies	
14. Analysis and verification of battery usage. Energy-aware programming techniques. Approximate computations. Techniques to control the battery usage	Exposure,description, explanation, discussion of case studies	

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8.2 Seminar / laboratory	Teaching methods	Remarks
1. (2^{nd} week) First Project: Use K-framework to describe the semantics of a sequential program	Use practical tools to implement a small project	Seminar is organized as a total of 7 hours – 2 hours every second week

2. (4^{th} week)Second Project: Use K-framework to describe the semantics of a concurrent program	Use practical tools to implement a small project	
3. (6^{th} week) Third project:Use Hip/Sleek to verify sequential programs.	Use practical tools to implement a small project	
4. (8^{th} week) Forth project:Use Verifast to verify concurrent programs	Use practical tools to implement a small project	
5. (10^{th} week) Fifth project:Use Hip/Sleek to verify the memory usage	Use practical tools to implement a small project	
6. (12^{th} week) Sixth project: Use Hip/Sleek to verify cpu and battery usage	Use practical tools to implement a small project	
7. (14^{th} week) Evaluation of the projects		
Bibliography Students will use the following tools: K-framework, Hip/Sleek and Verifast		

9. Corroborating the content of the discipline with the expectations of the epistemic community, professional associations and representative employers within the field of the program

- The course respects the IEEE and ACM Curriculla Recommendations for Software Engineering studies;
- The content of the course is considered by the software companies as important for software development skills

10. Evaluation

Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Share in the grade (%)
10.4 Course	- know the basic principle of the domain; - apply the course concepts - problem solving	Written exam	40.00%
10.5 Seminar/lab activities	– be able to implement course concept	-Practical examination	60.00%
10.6 Minimum performance standards			
➢ At least grade 5 (from a scale of 1 to 10) at both written exam and laboratory work.			

Date Signature of course coordinator Signature of seminar coordinator

..... Assoc. Prof. PhD. Ing. Florin CRACIUN Assoc. Prof. PhD. Ing. Florin CRACIUN

Date of approval Signature of the head of department

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