



University of
St Andrews



**Maynooth
University**
National University
of Ireland Maynooth



**UNIVERSITÉ
DE LORRAINE**

ERASMUS MUNDUS JOINT MSC IN ADVANCED SYSTEMS DEPENDABILITY (DEPEND)

THEMES & MODULESⁱ

THEMES

- **Theme 1: Rigorous Software Development (RSD)**

Learning outcomes: on completion of this theme, students will have gained skills and experience in the application of rigorous software development techniques to the production of highly dependable software systems. Students will be prepared to apply their learning to analyse, design, model, implement, and test software, applying domain-specific technologies in internet/web-based systems, databases, and cryptography, and based on an understanding of the fundamental principles of computation and object-orientation, in the research and development of highly dependable software systems.

- **Theme 2: Software Engineering (SE)**

Learning outcomes: on completion of this theme, students will have gained skills and experience in the application of general software engineering principles and practice, software architecture, and critical systems engineering. Students will be prepared to apply their learning in the research and development of highly dependable software systems.

- **Theme 3: Artificial Intelligence (AI)**

Learning outcomes: on completion of this theme, students will have gained skills and experience in the application of this key, state-of-the-art topic in the field of dependable software. Students will be prepared to apply their learning into artificial intelligence in the

research and development of software systems that use AI to achieve high levels of dependability in poorly specified or highly changeable environments.

- **Theme 4: Data Science (DS)**

Learning outcomes: on completion of this theme, students will have gained skills and experience in data-intensive systems, data mining, and knowledge discovery as applied to dependable software systems. Students will be prepared to apply their learning in the research and development of highly dependable, data-intensive software systems.

- **Theme 5: Formal methods for dependability (FSD)**

Learning outcomes: on completion of this theme, students will have gained skills and experience in the key, state-of-the-art fields of the application of formal methods to the analysis, design, development, and proof of software-based systems, with additional knowledge of the application of formal methods to data engineering, protocols, and cryptography along with supplementary skills in professional development.

- **Theme 6: Research and Experiential Learning (REL)**

Learning outcomes: on completion of this theme, students will have gained skills and experience in planning and executing research projects, and in working in and industrial or professional research environment. Students will be prepared to apply their learning in a work environment: be it in academic research, in industrial research, or an industrial development environment, producing advances in dependability of products with a high degree of dependability.

COURSE STRUCTURE

- Maynooth University: RSD, REL
 - 1st Year (60 ECTS)
 - Students take 6 taught modules, and complete a project/dissertation, over two semesters.
 - 2nd Year (60 ECTS)
 - Option 1: Students take 4 taught modules in semester 1 including a Minor Dissertation, and complete a 6-month industrial work placement in semester 2. Students must have achieved a minimum of 70% (common grading scheme) in their first year of studies to avail of this option.
 - Option 2: Students take 6 taught modules, and complete a project/dissertation, over two semesters
- University of St. Andrews: SE, AI, DS, REL
 - 1st Year (60 ECTS)
 - Students take 5 taught modules, and complete a project/dissertation, over two semesters
 - 2nd Year (60 ECTS)
 - Option 1: Students take 4 taught modules in semester 1, and do a placement (research or industrial via the EngD placement programme) in semester 2. Students must have achieved a minimum of 70% (common grading scheme) in their first year of studies to avail of this option.
 - Option 2: Students take 5 taught modules, and a project/dissertation over two semesters
- Université de Lorraine: FSD, REL (*Note: all material taught through English*)
 - 1st Year (60 ECTS)
 - Students take 15 taught modules and participate in the UL research internship programme producing a research dissertation
 - 2nd Year (60 ECTS)
 - Students take 15 taught modules and participate in the UL research internship programme producing a research dissertation

MODULESMaynooth University

Maynooth, Co. Kildare, IRELAND

Joint Module Code	Local Module Code	Short Title	60 ECTS
Core Modules (all must be taken)			
EMJM1	CS603	Rigorous Software Process	7.5 ECTS
EMJM2	CS607	Requirements & Design	7.5 ECTS
EMJM3	CS608	Software Testing	7.5 ECTS
EMJM4	CS629	Directed Reading (not available in the 2 nd year if CS631 the work placement is taken)	2.5 ECTS
Common Modules (only available if not previously taken, allocated by the consortium)			
EMJC1		Joint Programme Activities (new)	0 ECTS
EMJC2	CS613	Object Orientation (compulsory)	7.5 ECTS
EMJC10		1 st year summer school	0 ECTS
EMJC11		2 nd year summer school	0 ECTS
Specialisation Modules (RSD)			
EMJM10	CS605	Mathematics of Computer Science	7.5 ECTS
EMJM11	CS616	Cryptography	7.5 ECTS
EMJM13	CS619	Program Comprehension	7.5 ECTS
EMJM14	CS615	Internet Solutions	7.5 ECTS
EMJM15	CS621B	Databases	7.5 ECTS
EMJM16	CS656	Minor Dissertation (new module)	7.5 ECTS
EMJM17	CS610	Interaction Design	7.5 ECTS
Research and Experiential Learning Modules (REL) all must be taken unless annotated otherwise			
EMJM50	CS631	Industrial Work Placement ¹	30 ECTS
EMJM51	CS646	Project & Dissertation	20 ECTS

¹ Optional. Available in Year 2 (Semester 4) only. Assessment does not count towards final mark: students must submit a satisfactory report.

University of St. Andrews

St. Andrews, Scotland, UNITED KINGDOM

Joint Module Code	Local Module Code	Short Title	60 ECTS
Core Modules (all must be taken)			
		None.	
Common Modules (only available if not previously taken, allocated by the consortium)			
EMJC1		Joint Programme Activities (new)	0 ECTS
EMJC2	CS5001	Object Orientation (compulsory)	7.5 ECTS
EMJC10		1 st year summer school	0 ECTS
EMJC11		2 nd year summer school	0 ECTS
Specialisation Modules (SE)			
EMJS10	CS5030	Software Engineering Principles	7.5 ECTS
EMJS11	CS5031	Software Engineering Practice	7.5 ECTS
EMJS12	CS5033	Software Architecture	7.5 ECTS
EMJS13	CS5032	Critical Systems Engineering	7.5 ECTS
Specialisation Modules (AI)			
EMJS21	CS5010	Artificial Intelligence Principles	7.5 ECTS
EMJS22	CS5011	Artificial Intelligence Practice	7.5 ECTS
EMJS23	CS5012	Language and Computation	7.5 ECTS
Specialisation Modules (DS)			
EMJS31	CS5052	Data-Intensive Systems	7.5 ECTS
EMJS32	ID5059	Knowledge Discovery and Data Mining	7.5 ECTS
Optional Modules (at most 2 may be taken)			
EMJS1	CS4052	Logic and Software Verification	7.5 ECTS
EMJS3	CS5041	Interactive Software and Hardware	7.5 ECTS
EMJS4	CS5044	Information Visualisation and Visual Analytics	7.5 ECTS
EMJS5	CS5021	Advanced Networks	7.5 ECTS
EMJS6	CS5023	Mobile and Wireless Networks	7.5 ECTS
EMJS7	CS4204	Concurrency and Multi-Core Architecture	7.5 ECTS
Research and Experiential Learning Modules (REL) all must be taken unless annotated otherwise			
EMJS50	CS5899	Project & Dissertation	22.5 ECTS
EMJS51	CS5201	Special Project for Research Engineers (Placement) ²	30 ECTS

² Optional. Year 2 only. Research placement, or industrial placement via EngD programme.

Université de Lorraine

Nancy, Lorraine, FRANCE

Joint Module Code	Local Module Code	Short Title	60 ECTS
Core Modules (all must be taken)			
EMJL1		Advanced Software Engineering	2 ECTS
EMJL2		Non-classical Logics and Proofs	2 ECTS
EMJL3		Software Modelling	2 ECTS
EMJL4		Proofs of Programs	2 ECTS
EMJL5		Algorithmic Verification	2 ECTS
EMJL6		Project Management	2 ECTS
EMJL7		Integration of methods and tools (Project)	2 ECTS
Common Modules (only available if not previously taken, allocated by the consortium)			
EMJC1		Joint Programme Activities (new)	0 ECTS
EMJC10		1 st year summer school	0 ECTS
EMJC11		2 nd year summer school	0 ECTS
Specialisation Modules (FSD) - six must be chosen			
EMJL20		Proofs of Programs - Advanced Methods	2 ECTS
EMJL21		Semantics, Proofs and Types	2 ECTS
EMJL22		Decision Procedures for Program Verification	2 ECTS
EMJL23		Rewriting for Programming and Proving	2 ECTS
EMJL24		Data Engineering and Knowledge extraction	2 ECTS
EMJL5		Security of Protocols	2 ECTS
EMJL26		Advanced Cryptography	2 ECTS
EMJL27		Models of Computation	2 ECTS
EMJL28		Option (from another Master programme)	2 ECTS
EMJL29		Professional module	2 ECTS
EMJL30		Language Module: French	2 ECTS
Research and Experiential Learning Modules (REL) all must be taken unless annotated otherwise			
EMJL51		Internship - Research project (Semester 2)	30 ECTS

ⁱ We have done our best to ensure the accuracy of the information shown here, but we accept no responsibility or liability for any incorrect material.