

MSc Curriculum in Resilient Computing¹

Luca Simoncini

Professor of Computer Engineering

Faculty of Engineering, University of Pisa, Italy

Preferred duration: 25 minutes

1. Introduction

The Bologna process, to be completed in 2010, following the Bologna Declaration [1], requires to Universities and other higher education institutions:

- To profile their own curricula, in accordance with the emerging post-Bologna environment, in particular through the introduction of bachelor courses in systems where they have not traditionally existed, and **through the creation of master courses** meeting the needs of mobile postgraduate students from around the world.

In 2003, the Computing Research Association, has identified the following as one of Four Grand Challenges in Trustworthy Computing [2]:

- Challenge 4: **Secure the Ubiquitous Computing Environments of the Future** and identifies very strategic fields of activity necessary to fill gaps that limit the introduction of resilience in many complex computer-based applications.

Starting January 2006 and lasting three years, the EU has funded a NoE called ReSIST – Resilience for Survivability in IST [3], that collects 18 partners, among the most well-recognized groups in Europe expert in dependability, security and human factors that has among its objectives:

- **The promotion and propagation of a resilience culture in university curricula** and in engineering best practices.

ReSIST has therefore started a Training and Dissemination activity towards the preparation of an MSc curriculum in Resilient Computing as properly providing a timely and necessary answer to requirements posed by EU. ReSIST has already discussed with many European Faculties of Computer Science and Engineering and with professional Organizations like EWICS-TC7, and has produced [4]. An initial analysis of the situation in several leading Universities has shown that only individual courses on resilience are offered and none covers a full MSc curriculum in Resilient Computing. With the presentation to ECSS, ReSIST wishes to share its experience and to involve a much larger, open and qualified community in the discussion of the proposed curriculum.

2. Curriculum description

An MSc curriculum in Resilient Computing is composed by a total of 120 ECTS evenly divided in two years (60 ECTS each year). The curriculum should aim to provide knowledge to students so that they could be productive in industrial environments, having anyway a solid basic knowledge of the fundamentals and of the methods, techniques and tools related to resilient computing. The curriculum is organized into 4 semesters, two for each year, each tentatively 30 ECTS worth: the 1st semester on Basics and Fundamentals, the 2nd on Methods, Techniques and Tools, the 3rd on Projects in cooperation with industry on specific application fields, and the 4th for Master's Thesis and Dissertation.

The first phase of the curriculum (2 semesters, 60 credits), will provide core knowledge and skills through courses in: system dependability and security; advanced information security; human factors engineering; distributed and fault-tolerant computing; and system validation, ranging from theoretical bases to methods, techniques and tools.

In the second phase (3rd semester, 30 credits), the practice of resilient computing is emphasized, through courses in high-integrity software development and research skills, followed by a group project on the development and assessment of a real system in specific application domains (non exclusive examples of tracks reported).

The third phase of the curriculum (4th semester, 30 credits) is a six-month individual system development or research project, undertaken with personal supervision of one senior scientist

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(academia), or senior engineer (industry), and will be concluded with the preparation and discussion of a Master Thesis.

3. Curriculum organization

The curriculum is structured in 4 semesters (tentatively 30 ECTS each) over two years, as in the following Tables. The number of ECTS is not absolute but indicative of the relative weight among the several courses. Courses worth 6 ECTS are taught in parallel, while there is an ordering between courses worth 3 ECTS:

1st Year

1st semester: Basics and Fundamentals (30 ECTS)

Courses:

- **Advanced Probability and Statistics** (6 ECTS)
- **Cryptology and Information Security** (6 ECTS)
- **Logic in Computer Science** (6 ECTS)
- **Advanced Graph Theory** (3 ECTS)
- **Human Factors, Human and Organisational Behaviour** (3 ECTS)
- **Fundamentals of Real-Time Systems** (3 ECTS)
- **Fundamentals of Dependability** (3 ECTS)

2nd semester: Methods, Techniques and Tools (30 ECTS)

Courses:

- **Computer Networks Security** (6 ECTS)
- **Fault and Intrusion-Tolerant Distributed Systems and Algorithms** (6 ECTS)
- **Dependability Evaluation of Computer Systems** (6 ECTS)
- **Testing, Verification and Validation** (6 ECTS)
- **Usability and User Centred Design for Dependable and Usable Socio-technical Systems** (6 ECTS)

2nd Year

3rd semester: Projects (in cooperation with industry on specific application fields) (30 ECTS)

Courses (common to all application tracks)

- **Management of Projects** (3 ECTS)
- **Fault Tolerant Middleware-based Systems** (3 ECTS)
- **Software Reliability Engineering** (3 ECTS)

Application track: **Telecom.**

Courses (specific for this track):

- **Resilience of Protocols and Architecture** (3 ECTS)
- **Resilience of Mobile Applications** (3 ECTS)

Application track: **Safety critical Systems**

Courses (specific for this track):

- **Development Process and Standards for Safety critical Applications** (3 ECTS)
- **Architectural Issues and Examples of Systems** (3 ECTS)

Application track: **e-Business**

Courses (specific for this track):

- **Resilience of SOA and Web-based Applications** (3 ECTS)
- **Damage Tolerance in Large scale Systems** (3 ECTS)

Common to all Application tracks:

- **Project in cooperation with Industry** (9 ECTS)
- **Space for additional Courses** (6 ECTS)

4th semester: Master's Thesis and Dissertation (30 ECTS)

- **Specific Courses and Seminars** (3 ECTS)
- **Preparation and Presentation of the Thesis** (27 ECTS)

4. Curriculum Pre-requisites

A student who wants profitably enroll to the Curriculum in Resilient Computing would take advantage from having a basic knowledge in the following fields: Discrete Mathematics, Calculus, Basic Computer and Network Architectures, Programming and Data Structures, Basics of Operating Systems, Basics of Software Engineering, Basics of Probability and Statistics.

References

[1] <http://ec.europa.eu/education/policies/educ/bologna/bologna.pdf>

[2] <http://www.cra.org/reports/trustworthy.computing.pdf>

[3] <http://www.resist-noe.org/>

[4] Resilient Computing Curriculum Draft, Deliverable D16, ReSIST NoE, available at <http://www.resist-noe.org/deliverables.html>