PART 1: General Information

1. Scope: LTI/EDAM is a research-based doctoral program, aimed to explore solutions for complex industrial problems through problem-oriented and project-based activities. In order to achieve these objectives, the program emphasizes basic research in “engineering systems”, together with project-based activities in engineering design and advanced manufacturing, making use of a strategic partnership involving IST/FEUP/UMinho, together with MIT.

2. Implementation principles:
The program is based on individual student research plans, including two main parts, as follows:

2.1 Research thesis (180 ECTS): Every student should propose a dissertation topic to the Program Scientific Council (PSC), together with a supervisor, co-supervisors (if applicable), and a Dissertation Committee (DC), in order to monitor and step up research activities, following internal rules, including:

- The student must identify the supervisor and, where applicable, co-supervisors, together with the DC during the program 1st year, preferably before the end of the 1st semester. This process is supposed to start at the preparation stage of applying to the program and must be concluded as soon as possible, so that the student concentrates in his/her research activity;
- The student must identify and plan adequate research residences in research laboratories at IST/FEUP/UMinho, as well as in MIT, as adequate. This requires the identification of research supervisors in the institutions selected.
- The DC consists of at least 4 people and must guarantee the multidisciplinary nature of the program. The DC must meet with the student at least once a year during the doctoral program and submit written recommendations to the student and the PSC.
- All the students should clearly identify the best way to develop their own research work under the strategic partnership involving IST/FEUP/UMinho, together with MIT. This requires the individual student research plans consider research periods in at least two different institutions and the co-supervision by faculty and researchers associated with the various partner institutions.

2.2. Doctoral Courses (60 ECTS): Every student must follows the four following “tracks”:

- Research track: oriented towards the student thesis work and aimed to guarantee an effective research-based orientation of every student track since the early stages (i.e., since the very first day of student enrollment in the program). It should involve research residences in at least two different research laboratories and in one industrial environment, preferably in the first year, but to be completed before the end of 2nd year.
• **Seminar track**: involves the active participation in “design research seminars”, along the full duration of the program. It is compulsory in the first year and it should be oriented towards **writing a research paper** in close relation with the research residences to be developed under the “Research track”.

• **Academic track**: It involves 5 academic courses. It should last up to 24 months, preferably 12 months. It is based on “Problem-oriented, project-based” courses, oriented to help students writing research papers in the context of their doctoral thesis. It may consider options to be proposed by students, in order to foster student autonomy. One of this options may involve the practice of “Teaching Assistantship”, guaranteeing that each students works as “Teaching Assistant, TA”, for at least one semester.

• **Transferable skills development track**: to foster students skills in knowledge diffusion, innovation and technology leadership, as well as in understanding the job market and challenges for industrialization. It involves teamwork and the development of entrepreneurial-based projects.

3. **Orientation and institutional cooperation**: This program stands out from doctoral programs offered in traditional areas of engineering through the development of crosscutting and trans-disciplinary competences in “engineering systems”. This should be achieved through a strong inter-institutional cooperation and industry relationships, to be based upon the individual student research plans. This includes:

   • **Students should perform research residences across the institutions involved** in Portugal (IST, FEUP, UM) and at MIT. It is expected that, at least, all students awarded with FCT grants develop their research at least in two Portuguese institutions and at MIT.

   • Student supervisory teams should emphasize inter-institutional arrangements, preferably identified under the cooperation among IST, FEUP and UMinho, as per the program approved by the Foundation for Science and Technology, FCT under the MIT-Portugal Program. Within this framework, the DC must consider enhanced cooperation at national level, namely through student research residences at IST, UM and FEUP, among other potential partner institutions.

   • The DC must also ensure that enhanced cooperation with MIT is promoted, mostly in order to make sure that **all student experience research periods at MIT**. The joint co-supervision of students by MIT faculty members should be promoted, if adequate.
4. Overall Program lay-out (starting February 2015)

4.1. Research thesis: the entire program is based on an individual research plan, to be established for each student. Priority should be given to plans facilitating research residences in several institutions (IST, FEUP, UM and MIT) and involving supervisors from different institutions. All students are strongly recommended to develop their research plans with research periods in IST, FEUP and UM, as well as at MIT.

Duration: up to 48 months (i.e., 8 semesters, since student enrolment)

4.2. Doctoral Courses: each institution involved is responsible for its doctoral courses

Duration: up to 24 months (i.e., 4 semesters), but preferably 12 months (2 semesters)

5. Recommended student outcomes (“Qualification” for doctoral degree):

a) Preferably before month 6 (the latest, at month 12): identify research theme, supervisor(s) and a Thesis Doctoral Committee (DC).

b) Before month 24: a public seminar will be held by the student until 24 months after registering in the program. By the time of the public seminar the student should submit (to the DC): i) two research papers, in a publishable format; and ii) a dissertation proposal, with approximately 20 to 30 pages, including the review of relevant bibliography, the description of the research hypothesis and specific objectives, as well as the research proposal and any related project.

c) Before month 48: During the last DC meeting before submitting the final dissertation and requiring the appointment of the board of examiners, the student should submit (to the DC): i) at least two additional research papers, in a publishable format; and ii) a preliminary dissertation proposal, containing approximately 50 pages, including research papers.

Recommendation to students:
Doctoral thesis should consist of about four published research papers in peer-reviewed journals. It is strongly recommend that the four papers are effectively published by the time of the thesis submission. This set of papers should explore solutions for complex industrial problems through problem-oriented and project-based activities.

It is also recommended that the final thesis explicitly includes the research papers and a brief introductory and integrative chapter.
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<thead>
<tr>
<th>Academic Curriculum:</th>
<th>Seminar Track</th>
<th>Academic Track</th>
<th>Transferable Skills development Track (Innovation and technical leadership)</th>
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<tbody>
<tr>
<td><strong>Laboratory Rotation:</strong> Research Residence in two academic labs. Should involve research periods in IST, FEUP, UM 1st semester (6 ECTS)</td>
<td>Research seminar Annual: oriented to help students understanding research methods and practice and in writing a research paper by the end of the first year, in collaboration with research residences. 1st and 2nd semester (6 ECTS) (available along full program)</td>
<td>Product design 1st semester (6 ECTS)</td>
<td>Innovation and industry Policy 1st semester (6 ECTS)</td>
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<td><strong>Research Residence in Industry</strong> Between 2nd and 4th semester (6 ECTS)</td>
<td><strong>Product development, or an optional Advanced Engineering course</strong> (to be selected by the student, with relevance for the thesis; requires approval by SC) 2nd or 3rd or 4th semester (6 ECTS)</td>
<td>Engineering Systems and Research Methods 2nd semester (6 ECTS)</td>
<td>Innovation teams: entrepreneurial project, with team work (“Real world”) 2 semesters: 3rd and 4th semester (6 ECTS)</td>
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<td>Optional Advanced Engineering course, or Teaching Assistantship (at least one semester, at undergrad or master level) Between 1st and 4th semester (6 ECTS)</td>
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Total: 10 units x 6 ECTS/unit = 60 ECTS
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<thead>
<tr>
<th>Track</th>
<th>Course</th>
<th>Content</th>
<th>Student assessment</th>
<th>semester</th>
<th>Implementation</th>
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<tbody>
<tr>
<td>Research</td>
<td>Engineering Research (Métodos de Investigação em Engenharia)</td>
<td>Research-based course. Based on a Research Laboratory Rotation, with each student developing two “Research residences”, in two different labs, in relation to his/her thesis work. Research labs in different institutions (IST, FEUP, UM) should be considered. No classes; only laboratory research</td>
<td>Individual Research paper</td>
<td>1st semester (Feb-June)</td>
<td>Coordinated by “Seminar Coordinator”, in collaboration with student supervisors, on an individual student basis. It should involve research residences in different institutions (IST, FEUP, UM)</td>
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<td></td>
<td>Manufacturing Management (Gestão de Sistemas de Fabrico)</td>
<td>Research-based course. Involves an “Industry Research residence”, in industry, in relation to the student thesis work. It may involve a summer internship (about 2 months) in industry. No classes; only research in industry.</td>
<td></td>
<td>2nd or 3rd semester</td>
<td>Seminar may involve VC transmission.</td>
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<td>Seminar</td>
<td>Research Seminar (Seminários Tecnológicos)</td>
<td>Weekly seminar with invited speakers oriented to help students writing a research paper. Consider compulsory participation in the “Additive Manufacturing Lisbon design challenge 2015” weekly seminar, 2 hours/week; Thursday, 6-8pm</td>
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<td>Annual (Feb-June) (Sept-Dec)</td>
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<td>Academic Product Design (Design de Produto)</td>
<td>Project-based course. Each student must develop a virtual and physical prototype or a design-research paper in relation to his/her thesis work, making use of methods for generating ideas and front-end product development. Involves market research and technology evaluation, as well as the discussion of ideas for new products and establish product feasibility. Weekly class, 3 hours/week; <strong>Wednesday, 2-5pm</strong></td>
<td>Individual Research paper</td>
<td>1st semester (Feb-June)</td>
<td>Classes in design studio; one class a week, with reading materials; includes project work.</td>
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<td>Innovation and Industrial Policy (Gestão de Inovação)</td>
<td>Project-based course. Aimed to introduce doctoral students to industrial policy research and innovation studies. Approaches industrialization from quantitative and qualitative innovation research. Weekly class, 3 hours/week; <strong>Monday, 2-5pm</strong></td>
<td>Individual Research paper</td>
<td>1st semester (Feb-June)</td>
<td>Discussion classes, one a week, with reading materials</td>
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<tr>
<td>Engineering Systems and Research Methods (Sistemas de Engenharia e Projecto)</td>
<td>Project-based course. Aimed to introduce doctoral students to Engineering Systems and Research Methods. Weekly class, 3 hours/week; schedule tbc</td>
<td>Individual Research paper</td>
<td>2nd semester</td>
<td>Discussion classes, one a week, with reading materials</td>
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<td>Product development, or an optional Advanced Engineering course (Desenvolvimento de Produto)</td>
<td>i) Product development or ii) an optional Advanced Engineering course (to be selected by the student, with relevance for the thesis; requires approval by SC). Any course offered at IST or in any partner institution (FEUP, UM, MIT) in a relevant theme may be considered.</td>
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<td>2nd or 3rd or 4th sem.</td>
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<tr>
<td>Optional Advanced Engineering course, or Teaching Assistantship (Gestão para a Engenharia)</td>
<td>i) Optional Advanced Engineering course, or ii) Teaching Assistantship (at least one semester, at undergrad or master level)</td>
<td></td>
<td>1st, 2nd or 3rd or 4th sem.</td>
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| Transferable skills develop. | **Innovation Studies**  
* (Inovação e empreendedorismo) | Project-based activity, involving the development of an industrialization strategy in team work  
Involves a few workshops in the form of “Engineering Design Roundtables”. | Group Research paper  
(schedule tbc) | Annual: 1st and 2nd semesters  
(1st year) | Group work along one year |
| --- | --- | --- | --- | --- | --- |
| **Innovation Teams**  
* (Liderança) | 6 ECTS | Project-based activity, involving an entrepreneurial project in team work  
Involves a few entrepreneurship workshops and “hands-on” project activity. | Group Research paper  
(schedule tbc) | Annual: 3rd and 4th semesters  
(2nd year) | Group work along one year |