



Università degli Studi del Sannio, Benevento, ITALY

Doctorate Course in “Information Technologies for Engineering” (ITE)

Corso di dottorato di ricerca in “Tecnologie dell'Informazione per l'Ingegneria”

General presentation and study plan (Cycle XXXVIII)

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Reference

The PhD course in *Information Technologies for Engineering* (ITE) follows the regulations established by the University of Sannio regulations for the Ph.D. courses, published with Rectoral Decree n. 335 on March, 15, 2022:

https://www.unisannio.it/sites/default/files/sito/ateneo/amministrazione/avvisi/uo-post-laurea/it/REGOLAMENTO DI ATENEO IN MATERIA DI DOTTORATO DI RICERCA DR%20335_2022.pdf

Presentation of the course

The PhD course in *Information Technologies for Engineering* (ITE) aims at deepening theoretical and practical aspects of information technologies and applying them to develop applications in a number of domains under the guidance of experts. The course is characterized by a variety of teaching and research topics, often related to on-going national or European research projects, promoted by the researchers of the Department of Engineering of the University of Sannio.

We aim at educating researchers with a sound scientific background and a specific culture of design in different areas of application, with an interdisciplinary approach and a vision towards the creation of new solutions. This will enable the conception and development of innovative solutions and investigation methodologies, a basis to perform advanced research in public and private enterprises with scientific and technical competence, and a managerial attitude.

Educational Objectives

The education is directed to the acquisition of methodological, technological, theoretical and experimental tools, either traditional or innovative, to be utilized for modelling, designing, prototyping/simulation and testing of information technologies and their applications to complex information, mechanical, energy, electrical systems and civil work in a natural or anthropic environment.

The objective is also to stimulate the development of a spirit of entrepreneurship.

The education will be complemented with international exchanges or internships at public or private research labs.

The course comprises two curricula, Information Technologies and Energy and Environment.

The curriculum in Information Technologies aims at studying topics related to different disciplines of information engineering. The student will be able to develop novel research in disciplines such as computer science and engineering, automation, electronics, measurements, electromagnetic fields, and telecommunication. Also, a prospective student may develop novel applications of information technology to other engineering and science domains.

The curriculum in and Energy and Environment aims at forming researchers able

to acquire and develop knowledge and competencies in the research fields of civil and industrial engineering. In particular, the students will investigate, through novel approaches and methods, the development, modeling, and sustainability of transport, hydraulic, construction infrastructures, the optimization of energy consumption in particular within buildings, the systems for the production, transmission, distribution and usage of energy, chemical process, quality assurance of industrial and production processes.

Employment Outlook

A PhD in ITE offers a wide range of job opportunities based on the capabilities, acquired during the course, to manage research activities, write high-quality scientific and technical reports, develop practical results, collaborate within workgroups in national or international partnerships, with a good knowledge of the English language, written and spoken.

Students that graduated in ITE at the University of Sannio will be fit for employment in both private and public institutions. Just as an example, five Engineering Schools and a number of Research laboratories of CNR, ENEA, INFN, and other government research agencies operate in the Campania Region. There exist a number of local employment opportunities as postdocs in research and teaching activities. More broadly, our alumni were able to find prestigious academic and industrial positions both in Europe and in the US.

The doctors graduated in our Ph.D. program will be able to find jobs in public and private centers, whose products and services are related to information technology, or can be developed efficiently, effectively, and with high sustainability by leveraging such pieces of technology. The doctors will contribute to the research, innovation, and technological transfer in different fields, including:

- Design and management of software systems, cyber-physical systems, distributed systems;
- Network and application security;
- Modeling, simulation, and design of antennas, wireless and cabled links, and microwave devices;
- Modeling and prototyping of systems for electrical measurements in telecommunication, aerospace, biomedical systems, and industrial manufacturing;
- Design and simulation of sensors and systems for the acquisition and processing of satellite data;
- Industrial process automation;
- Management and planning of energy and electrical resources (on a local, national and international scale);
- Modeling, simulation, and design of systems for energy conversion and management;

- Simulation and design of chemical plants and combustion processes;
- Modeling and analysis of complex components and innovative materials in areas such as automotive, aerospace, railways, biomedical systems, telecommunications, and civil engineering;
- Computer-assisted design in civil engineering;
- Simulation of structures and systems subject to dynamic stress.

The Work Programme

A tutor is appointed for each student. During the first year the tutor will be one (or more) of the researchers and professors of the Department of Engineering, after whom an external scholar, approved by the school, can be added.

The course lasts 3 years during which the student must take courses, perform research, write papers (and get them published), and develop a Ph.D. thesis.

Activity	Year	CFU	CFU/YEAR
1st YEAR			
Exams	Ph.D., Masters' or Bachelors' courses	18	60
Seminars	Soft skills	4	
Research	Study/research	36	
Reporting	Final year report	2	
2nd YEAR			
Exams	Ph.D., Masters' or Bachelors' courses	6	60
Research	Study/research	52	
Reporting	Final year report	2	
3rd YEAR			
Research	Study/research	40	60
Reporting	Thesis preparation/writing	20	
		TOTAL	180

As shown in the Table above, the study plan consists of a total of 180 CFU (credits).

Of these, 24 are related to exams, 4 to acquiring soft skills (e.g., technical writing, presentations, research management), 128 related to study and research, and 24 for reporting and thesis writing.

The teaching activities specific to the Ph.D. program will be related to (1) topics specific to information engineering, including enabling technologies, empirical methods, and research methods, (2) topics related to other engineering fields. Such activities will be complemented by soft skills related to technical writing,

presentation, and research organization.

Students can freely choose any course, provided that, for Masters' or Bachelors' courses, they have not previously taken them. There is no fixed prerequisite, and the students can place the courses in the first or second year at their choice.

The choice of the courses must fulfill the following criteria:

- The English course (6 CFU) is compulsory, unless the student is native English speaker (in that case the course must be replaced by a different one) or the student has acquired an ESOL certificate at least equivalent to C1 level.
- Up to 9 CFU can be filled by courses provided by other PhD programs (e.g., other Departments or Universities), or courses in PhD schools, pending approval by the Doctorate Committee. Also, up to 9 CFU can be filled by Masters' or Bachelors' courses (not previously taken, pending approval by the Doctorate Committee).
- It is possible to choose max. 12 CFU from courses taken in other Universities;
- It is possible to choose max. 6 CFU from PhD schools and mini-courses.

It needs to be emphasized that, in all cases, *acquisition of credits requires a formal exam at the end of the course.*

A "credit" is defined as a number of hours of study (typically 25) including both class attendance and home study in a ratio of approximately 1:3. In consideration of the "high level" of the courses taught to Ph.D. students and their presumed familiarity with study method and rhythms, less class attendance is required to earn a credit, and more home study. In particular, to earn 1 credit it is necessary to attend 6 hours of lectures, followed by approximately 19 hours of study; the combination is assessed through a final exam. As a consequence, attending seminars does not provide credits *per se*.

Credits cannot be earned by attending a course taught by the PhD student's tutor.

Courses are taught in English; they may be taught in Italian if no foreign student is attending.

Each year the student presents his/her study plan, pre-agreed with the tutor, through the Enrollment system. The study plan is then approved by the Doctorate Committee.

A limited number of hours (no more than 40) may be devoted to activities of teaching assistantship, according to the tutor's indications. Whenever available, the University may provide scholarships for teaching assistantship and undergraduate students' tutoring. These scholarships will be assigned to applicants based on the results of an interview.

Further hours (no more than 20) can be devoted to technological transfer activities, according to the tutor's indications.

The students will carry out their activities by leveraging the premises, equipments, and libraries provided by the University of Sannio. Wherever appropriate or required, the student can perform an internship in industry or in another university abroad.

The **research activity** is devoted to the development of research products worth publication in scientific papers in prestigious archival journals and presentation at major conferences. The contributions of the various papers produced along the course can be included in the final PhD thesis with the goal of forming a comprehensive, self-contained, and far-reaching piece of work.

Students are expected and encouraged to spend at least 3 months at another research institution, preferably abroad, to improve their knowledge and widen their cultural horizon. During the stay, the scholarship is increased by 50%. These external periods need to be authorized in advance by the Doctorate Committee.

Proficiency evaluation

Each year the students' activities are evaluated by the Doctorate Committee that decides on the admission of the student to the next year of the course or to the final exam. To this aim, a smaller panel for the admission to the second or third year may be appointed by the Doctorate Committee.

For admission to the second year students must deliver a 15' presentation, preferably in English. For admission to the third year, students must deliver a 20' presentation, preferably in English. After the end of the third year, students submit a draft of their final thesis to two external reviewers indicated by the tutor, approved by the Coordinator, and appointed by the Rector. Reviewers are given 6-8 weeks to examine the work; they can accept or reject it or require revisions. A "major" revision may require up to 6 months of additional work and needs another review.

Students are admitted to the final exams by a panel nominated by the Doctorate Committee on the basis of:

- Their three-year curriculum,
- A 40' presentation of their work,
- The reviewers' comments.

The final version of the thesis is submitted to a Committee, appointed by the Rector, formed by 3 professors/researchers, experts in the scientific area of the thesis; no tutor of the candidate may participate in the Committee and not more than one of its members is allowed to be an "internal" professor. After a few weeks needed for examination of the thesis, the Committee gathers with the candidate to hear its formal presentation and eventually awards the degree.

At student's request, the University of Sannio may attach the label of *Doctor Europaeus* to the PhD degree when the following four conditions have been fulfilled:

1. The two external reviewers of the thesis are professors from two higher education institutions of two European countries, other than Italy;
2. At least one member of the examination Committee comes from a higher education institution in European countries, other than Italy;
3. Part of the defence must take place in one of the official European languages, other than Italian;
4. The PhD thesis has been prepared as a result of a period of research of at least one trimester spent abroad.

Teaching support

Ph.D. students cannot formally teach a University course. However, they can perform supporting activities to the teaching (i.e., be teaching assistant) for a maximum of 40 hours per year.

Technological transfer ("attività di terza missione")

Ph.D. students can contribute to technological transfer activities for a maximum of 20 hours per year. Note that, according to the University regulation, paid activities are subject to authorization from the Doctorate Committee.

Coherence with the PNRR objectives

The PhD course in "Information Technologies for Engineering" aims to develop research activities in collaboration with companies and public administrations on topics relevant to the PNRR. The PhD program intends to support research related to "digital and environmental transition" and "public administration", as well as general issues related to the PNRR.

Moreover, the PhD course will propose innovative doctorates that respond to the innovation needs of companies, and promote the hiring of researchers by companies.

The PhD course aims to address research topics relevant to the general macro-objectives and areas of intervention, following the main economic and social challenges to be addressed: Digitization, innovation, competitiveness and culture; Green revolution and ecological transition; Infrastructures for sustainable mobility; Education and research; Inclusion and cohesion; and Health.

Concerning the programs dedicated to digital and environmental transitions, the PhD course fully covers the related areas – in particular area 09 (21 college members) and area 08 (6 college members), but also 01 (1 member of the college). The teaching activities will also place a special emphasis on issues related to these aspects (on one hand, artificial intelligence and safety, on the other, issues related to energy efficiency and climate change). It should also be emphasized that the PhD course has a specific curriculum on "energy and the environment".

The strong presence of area 09, as well as the aforementioned teaching and in-depth activities, will make the doctoral program particularly suitable for courses related to public administration.

Thanks to the teaching activities provided, but also thanks to the specific background of the members of the PhD Committee and the tutors, it will be possible to place particular emphasis on conducting research aimed at ensuring open access to results and data, according to the principles "Open science" and " FAIR Data ".

Finally, thanks to collaborations with local companies, the PhD course intends to contribute with "innovative doctorates that respond to the innovation needs of companies and promote the hiring of researchers by companies". For this purpose, the PhD course has collected expressions of interest (through letters of intent) from companies willing to co-finance PhD scholarships.

For all doctorates where this is deemed necessary and appropriate, thanks to the partnership with companies and public administrations, and thanks to the collaborations with foreign universities by the members of the PhD Committee, the PhD course includes periods of study and research in companies, public administrations, or at foreign institutions.

Admission procedure

Each year at least 8 students are admitted to the course. More positions may be available, subject to availability of funds for additional scholarships, typically from on-going research projects. The call for applications is issued in July or September. The selection, on a competitive basis, is conducted in time to start the course by November 1st of each year.

The selection is made by an admission Committee appointed by the Doctorate Committee and is based on evidence from the following items:

- The *curriculum vitae et studiorum* of the candidate;
- The exams' transcript, with the weighted average grade. For foreigner students, it must be necessary to indicate, in the application form, the minimum and maximum grade;
- A motivation letter;
- Letters of reference;
- A copy of the M.Sc. thesis (if completed) with an abstract in English. If the thesis has not been completed, an abstract of the ongoing work is sufficient;
- Interview with the student.

The interview is based on presentation and discussion of a research project/topic chosen by the candidate, and includes an evaluation of English language skills. The interview can take place in "teleconference".

Admission requirements

In order to be admitted to the Ph.D. course, the student must possess one of the following degrees:

Italian M.Sc. "Laurea Magistrale" or "Laurea Specialistica":

- LM-4 Architettura e ingegneria edile-architettura
- LM-6 Biologia
- LM-7 Biotecnologie agrarie
- LM-8 Biotecnologie industriali
- LM-9 Biotecnologie mediche, veterinarie e farmaceutiche
- LM-17 Fisica
- LM-18 Informatica
- LM-20 Ingegneria aerospaziale e astronautica

- LM-21 Ingegneria biomedica
- LM-22 Ingegneria chimica
- LM-23 Ingegneria civile
- LM-24 Ingegneria dei sistemi edilizi
- LM-25 Ingegneria dell'automazione
- LM-26 Ingegneria della sicurezza
- LM-27 Ingegneria delle telecomunicazioni
- LM-28 Ingegneria elettrica
- LM-29 Ingegneria elettronica
- LM-30 Ingegneria energetica e nucleare
- LM-31 Ingegneria gestionale
- LM-32 Ingegneria informatica
- LM-33 Ingegneria meccanica
- LM-34 Ingegneria navale
- LM-35 Ingegneria per l'ambiente e il territorio
- LM-40 Matematica
- LM-44 Modellistica matematico-fisica per l'ingegneria
- LM-53 Scienza e ingegneria dei materiali
- LM-54 Scienze chimiche
- LM-66 Sicurezza informatica
- LM-91 Tecniche e metodi per la società dell'informazione
- 4/S (specialistiche in architettura e ingegneria edile)
- 20/S (specialistiche in fisica)
- 23/S (specialistiche in informatica)
- 25/S (specialistiche in ingegneria aerospaziale e astronautica)
- 26/S (specialistiche in ingegneria biomedica)
- 27/S (specialistiche in ingegneria chimica)
- 28/S (specialistiche in ingegneria civile)
- 29/S (specialistiche in ingegneria dell'automazione)
- 30/S (specialistiche in ingegneria delle telecomunicazioni)
- 31/S (specialistiche in ingegneria elettrica)
- 32/S (specialistiche in ingegneria elettronica)
- 33/S (specialistiche in ingegneria energetica e nucleare)
- 34/S (specialistiche in ingegneria gestionale)
- 35/S (specialistiche in ingegneria informatica)
- 36/S (specialistiche in ingegneria meccanica)
- 37/S (specialistiche in ingegneria navale)
- 38/S (specialistiche in ingegneria per l'ambiente e il territorio)
- 45/S (specialistiche in matematica)
- 50/S (specialistiche in modellistica matematico-fisica per l'ingegneria)
- 61/S (specialistiche in scienza e ingegneria dei materiali)
- 62/S (specialistiche in scienze chimiche)
- 100/S (specialistiche in tecniche e metodi per la società dell'informazione)

Degrees earned before D.M. 509/99 and equivalent to the above ones are also admitted.

For foreign students: Master degree or equivalent degree in Computer Science, Biomedical Engineering, Electrical Engineering, Computer Engineering,

Software Engineering, Mechanical Engineering, Civil Engineering, Chemical Engineering, Energy Engineering, Aerospace Engineering, Mathematics, Physics, Material Science

Note: when applying, the student must at least possess a Bachelor's Degree (Laurea Triennale). However, in order to enroll to the Ph.D. program, the M.Sc. must be earned by October 31 of the year (2021 for the 37th cycle).