Systems Engineering and Informatics

Goals of the study program

The aim of the doctoral study program System Engineering and Informatics (DSP SYEI) is to develop students' ability to work independently as well as team-based scientific and scientific work, to support the study of demanding scientific and professional literature and to teach them to apply the results achieved in practice. The aim is that the graduate of the study is an expert highly competent especially in the areas of:

- General methodology and methods of professional and scientific work;
- Creative work in an interdisciplinary work teams, systems thinking and thinking to solve problems in different areas of human activity;
- Systems Theory and applied Systems Sciences, mathematical and statistical modeling and simulations;
- Data analysis and processing to address well structured, partially structured and unstructured problems;
- Applied Informatics, Artificial Intelligence Methods and Big Data Processing;

and in other areas according to the chosen profile.

Graduate's profile of program SYEI

The doctoral study program System Engineering and Informatics focuses on study and dissemination of the results of top research in the field of General Systems Theory and Applied System Sciences, Applied Informatics, Economic Informatics and Mathematical and statistical modeling. The study program is designed interdisciplinary with a strong emphasis on theoretical education and the students' ability of own research work. The intention is to interconnect the areas of System Sciences, System Theory, Operational Research, Mathematical and statistical methods, Project management, Theoretical software engineering, and modern Information systems and data modeling tools for decision-making and management support systems in organizations and for the creation and application of Enterprise information systems.

The intention of the study program corresponds to the development of the knowledge society. It focuses on the theory and application of a systems approach for the description of current problems and the use of exact methods for solving them and expanding these areas from theoretical and practical point of view. Furthermore, it deals with the development of economic informatics, information and communication systems for real social and economic systems with the aim to theoretically formulate and practically apply the requirements for information systems and information models.

Graduate of Doctoral degree in Systems Engineering and Informatics will gain knowledge, skills and experience that will enable independent professional and scientific work as well as high ability to implement theoretical results of the area of Systems Sciences, Mathematical and statistical modeling, Project management, Information systems, Information management and Economic informatics. He/she will master general methods of scientific work, gain theoretical knowledge in the chosen field at a level that will enable the application of these results in the economics, management theory, or other technical or social areas. He/she will also be able to acquaint the professional public with the results of his work and train qualified specialists in application primarily for economic problems and management of organizations.

Graduates will be able to work especially in the following positions:

- Independent researcher in academic institutions or in institutions involved in scientific research;
- Knowledge engineer;
- Systems integrator;
- Senior analyst and consultant;
- Analyst and designer of intelligent solutions for precision agriculture.

Study requirements

The study is based on an approved individual study plan (ISP). The ISP must be compiled to include all of the following study obligations and to ensure that the student has obtained at least 240 credits. The following are compulsory and optional study obligations and their recommended inclusion in individual years of study. Credit ratings are given in the Credit System.

Dissertation methodology

Students submit their dissertation methodology after approval by the supervisor within 12 months from the start of the study. The methodology is defended and contains mainly the research plan of the dissertation, see other study obligations.

Academic writing

A compulsory subject that will be taught in the 1st year of study, which aims to increase the student's ability to use English at a professional or scientific level, as it will be necessary to work with foreign language literature, undertake internships abroad, communicate with partners abroad, produce outputs and present results of his/her

work in English, etc. The course will be taught in the form of contact seminars in English. Teaching will be conducted by a teacher with language competence at the level of a native speaker who carries out his/her own research activities and has experience in publishing in quality scientific journals.

Methodological Seminar

Seminar focused on methods of scientific work, work with information sources, ethics of scientific work, presentation of results of research activities and their evaluation, obtaining resources for research realization and other key topics that will enable the student to move from master's level to doctoral level. The seminar is included in the 1st year of study and the graduate obtains the necessary knowledge for the creation of the doctoral thesis methodology.

Compulsory subjects

The student of DSP System Engineering and Informatics completes the following compulsory subjects in the first or second year of study.

- *Contemporary Issues in Systems Engineering* - a compulsory subject taught in the form of a seminar, the aim of which is to acquaint students with the latest scientific results in the area of System Sciences and Mathematical and statistical modeling.
- *Modeling of dynamic properties of information systems* - compulsory subject taught in the form of a seminar, the aim of which is to acquaint students with the latest scientific results in the field of informatics, information science and economic informatics with a focus on modeling information systems and their special properties.

Optional subjects

The students of DSP System Engineering and Informatics can complete optional subjects in the first or second year of study (at the latest in the third year). Depending on the interest and focus of the scientific work, the students can select courses primarily from the following:

- *Methods of Artificial Intelligence*
- *Mathematical modeling and simulation*
- *Big Data Processing*
- *Internet of Things*
- *Modern trends in programming*
- *Data Processing Methods for GIS*
- *Knowledge Modeling*
- *Special methods and models of Project Management*
- *Statistical modeling*
- *Statistical forecasting*
- *Statistics in Data mining*
- *Dynamic optimization models*

Successful completion of compulsory or optional subjects requires the creation of at least one of the following outputs:

a) Scientific article ready for publication
b) Critical analysis of published work by a renowned author in the field
c) Review study of selected scientific field
d) New application of the selected scientific procedure

The aforementioned outputs serve as a basis for the professional debate to be conducted within the exam. The student will pass the exam based on the success in the professional debate.

After approval by the supervisor and approval by the Doctoral Degree Programme Boards, the student may also choose another optional subject from the offer of accredited DSPs on CULS or other institutions in the Czech Republic or abroad.

Literary review for the dissertation

Basis for the state doctoral exam, which includes especially the literature review and content of upcoming dissertation. The thesis is reviewed, the debate on the thesis is part of the state doctoral examination.

State Doctoral Exam

The state doctoral exam in DSP System Engineering and Informatics consists of three parts:

- Professional debate on the submitted theses of the dissertation and the problems dealt with in the dissertation;
- Debate on a selected area of the general subject *Systems Engineering and Informatics*, which includes topics from the following key areas
    o Systems Science
    o Systems Theory

- o Informatics and Information Science
- o Statistics
- o Operational Research
- Debate on a selected field of the specialized subject *Special Tools of Systems Engineering and Informatics*, which includes topics
  - o Modern systems tools
  - o Project Management
  - o Special mathematical models and simulations
  - o Special statistical models
  - o Data mining
  - o Information and communication systems
  - o Internet of Things
  - o Artificial intelligence
  - o Big data
  - o Geographic information systems

The subject areas for discussion in both subjects and their updating are approved by the Doctoral Degree Programme Boards.

Dissertation defence

In the fourth year of study, the students are mainly interested in completing their dissertation. Their duty is to defend their dissertation work within the standard period of study.

Publication activity requirements

The minimum requirements are:

1) The DSP student must be the first author of at least one publication published or accepted for publication in a Web of Knowledge journal with a non-zero Impact factor index (IF) assigned in the publication year of the publication or in the SCOPUS journal with non-zero Scientific Journal Ranking Index assigned (SJR) in the year of publication. Without fulfilling this requirement, the student is not allowed to defend his/her dissertation.

2) The DSP student must present at least once a year the results of his/her work at a recognized professional forum, scientific conference, symposium or seminar. Compliance with this obligation is confirmed by the supervisor and is also subject to evaluation by the Doctoral Degree Programme Board within the framework of the annual attestation.

Beyond these minimum requirements, the student may include additional creative activities in his/her ISP.

Requirements for study visits

The individual study plan must include a foreign study visit of a total duration of at least one month. The recommended inclusion of this activity is in the second or third year of study.

The fulfillment of this obligation can be replaced by the student's active participation in solving of an international research project with results published or presented abroad. The supervisor, the head of the department, and the Doctoral Degree Programme Board approve the fulfillment of this requirement in this form.

Another study obligation

Dissertation methodology defence

During the first year of study, each DSP student of System Engineering and Informatics elaborates the Dissertation Methodology. The dissertation methodology mainly includes the research plan of the dissertation and the student elaborates it using knowledge from the Methodological Seminar, completed subjects, self-study and consultations with the supervisor. The framework curriculum of the dissertation is approved by the Doctoral Degree Programme Board. The student submits the dissertation methodology after being approved by the supervisor within one year from the start of study. The methodology is reviewed by one member of the field council and the DSP student then defends it in front of a committee set by the Doctoral Degree Programme Board. Successful defence of the Dissertation Methodology is a necessary precondition for progress to the second year of study.

Teaching Practice

Part of the duties of study in the DSP System Engineering and Informatics is also pedagogical practice, serving primarily to develop presentation experiences. As a rule, this practice lasts for at least four semesters on an average of four hours per week per academic year.