ÓBUDAI EGYETEM
ÓBUDA UNIVERSITY

CURRICULUM OF THE DOCTORAL SCHOOL ON SAFETY AND SECURITY SCIENCES

BUDAPEST, 2024.

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Curriculum of the Doctoral School on Safety and Security Sciences

Security Science is an engineering discipline in which research and development tasks motivated by real needs can be achieved through the high-level integrated cultivation of several disciplines. New scientific results from research are applied to ensure that a critical system behaves as intended, *even in the event of failure of system components, external disturbances or dysfunctional interaction between components*.

As a field of research, safety science deals with topics that are distant from each other in *terms of traditional discipline classification, such as* accident prevention, management of hazardous substances, occupational hygiene, occupational safety and ergonomics, operation and maintenance, noise protection, risk assessment and risk management, economics and business aspects of safety. Scientists researching and publishing on these topics range from psychologists, chemical, mechanical and electrical engineers to military scientists. Physics, manufacturing technology, social and political phenomena, management sciences, control theory, law, business, human behavior are all included.

Today, the understanding of security has become a major social, economic, and political factor. At the international level, NATO and the European Union have developed their concepts and regulatory approaches to security. Today, maintaining safe living and working conditions and sustainable security have also become a governance issue.

In addition to the general need for universal scientific knowledge, this paradigm shift has also resulted in new, specific research needs in the security sciences, which have been reflected in the international scientific community. A natural framework for this is provided by the scientific-research and professional-public system. Without wishing to be exhaustive, we highlight some leading professional and scientific organisations, impact factor journals and annual scientific conferences:

- *organisations* (e.g.: IEEE Reliability Society, IEEE's Product Safety Engineering Society, Information Systems Security Association, Safety and Reliability Society, The International Association of Safety Professionals, International Ergonomics Association, American Society of Safety Engineers, British Security Industry Association, Canadian Society of Safety Engineering),

- *journals with impact factor* (e.g. Accident Analysis & Prevention, International Journal of Occupational Safety & Ergonomics, Journal of Hazardous Materials, Journal of Loss Prevention in the Process Industries, Journal of Risk Research, Journal of Safety Research, Reliability Engineering & System Safety, Safety Science, Security Journal, The International Journal of Safety and Security Engineering),

- *annual scientific conferences* (e.g. SPIE Defense, Security, and Sensing (USA), Singapore International Security Conference, Safety in Action Conference (Australia), SAFE International Conference on Safety and Security Engineering (Belgium), OPS Safety and Security Leadership Conference (Canada), Michigan Safety Conference (USA), Integrated Research on Disaster Risk Conference (China), Industrial Automation Safety and Security Symposium (USA)).

Higher education institutions have contributed greatly to the development of security science worldwide. In time, it was recognised that security can only be addressed in a complex way, that natural needs and expectations can only be met by integrating knowledge. This requires the integration of the disciplines concerned. This is also reflected in the master's and doctoral programs in security engineering at the relevant institutions, as some international examples show below:

- *Master's degree*: Potsdam Universität (network security); Universitat Rovira i Virgili (intelligent systems security); Coventry University (safety and security); Eastern Kentucky University (security and emergency management); National University USA (national security and safety engineering); Texas Tech University (multiple majors); University of Houston (public safety organizer); Kansai University (man-made accident management); Swinburne University of Technology (emergency management); University of Science and Technology of China (security engineering).

- *doctoral training*: University of London (several PhD programs); University of Manchester (biometric identification and its applications); University of Stavanger (risk management and social security in a multidisciplinary approach); Texas Tech University (several PhD programs); Northcentral University (computer and information security); UCCS University of Colorado (multi-disciplinary research in physical, national, IT security); University of Alabama at Birmingham, Auburn University (workplace safety and ergonomics); Kyushu University (materials, material structures in relation to safety and reliability); Wuhan University of Technology (safety engineering PhD).

The reflection of the relevant actors in Hungarian higher education was far from quick: there was no doctoral program in safety and security sciences in 2012 in any institution yet. Therefore, it is clearly justified, and even necessary - taking into *account international trends and the socio-economic processes in Hungary* - that Óbuda University, which is the most involved in the training of security engineers, should react to the paradigm shift and launch a training program for scientists capable of researching complex security problems in a creative way, at a level beyond the basic and master's degrees in security engineering, being the first in Hungary.

The aim of the Doctoral School on Safety and Security Sciences is to train technical researchers who are able to go beyond the traditional, disciplinary approach and who are able to solve research and development tasks based on real industrial needs by applying their knowledge

in a synergistic and creative way. In this way, the boundaries between previously sharply separated disciplines are blurred, and the project-oriented approach required to solve practical problems generates synergies between disciplines, creating a new kind of security science "knowledge triangle".

The core members of the Doctoral School have already collaborated extensively in their research. At the same time, one of the fundamental goals of the Doctoral School is to ensure that the core members, supervisors, lecturers and visiting professors not only strengthen their own research topics, but also complement each other in generating new research topics of an interdisciplinary nature, and that the talented young people working on them achieve significant results by international standards.

1.1. Structure of the training program

In line with the principles outlined above, the Doctoral School draws on safety and security science-oriented disciplines in engineering modelling and simulation, robotics, mechatronics, control theory, informatics, intelligent engineering systems, computer-aided manufacturing, etc. It uses their tools to solve problems but differs from them in that the analyses and methodological developments are aimed at solving the safety problem effectively. This requires a thorough knowledge of the specific application domain and intensive and deep cooperation with the relevant disciplines/experts.

The doctoral school will focus on the following priority topics, which are often at the forefront of industry's scientific challenges:

- modelling in security sciences (security science, security risk modelling and analysis; intelligent methods in security science),
- critical infrastructure protection (critical system security; critical information infrastructures; info communications networks),
- security and reliability of information systems (information security; information security management systems; imaging information; biometric identification),
- safety issues of human-machine systems (safety of human-robot interaction; failure dynamics of human-machine systems; safety issues of mobile robots),
- safety issues in man-environment systems (electronic monitoring and control systems; complex object protection systems; mechanical and human protection; accident risks; hazardous waste; use of non-lethal weapons),
- operational and operational safety (mechanical, electronic, mechatronic equipment; emergency management).

In the above areas, Óbuda University has significant intellectual resources and national and international research (academic and industrial) collaborations.

1.2. Structure of the doctoral school's curriculum

The doctoral program consists of 8 semesters. During the 8 semesters, the student must complete 240 credits in order to obtain the PhD degree, as follows:

- Subjects: at least ***48 credits***, with ***6 credits*** per subject.
- Semester research and study report (written and oral):
  - ***Semesters 1-4: 8-8 credits***,
  - ***Semesters 5-8: 15-15 credits*** (total over 8 semesters: *92 credits*).
- Publications related to the research topic: ***at least 75 credits***.
- Active participation in a research project: ***6-10 credits/project***.
- Course participation: ***maximum 60 credits*** (no compulsory minimum), 1 contact hour per week (1x45 min) = 2 credits.

According to the credit regulations, students must take a ***minimum of eight (8)*** courses and pass an examination. Of the eight courses, ***four are compulsory*** basic courses related to the doctoral topic, of which ***two*** *(in the category of basic courses in the field of safety and security studies) are in the field of safety and security science* ***and two*** (in the category of research topic related basic courses) are in the field *of research.* These **4** subjects are approved by the Doctoral School Council on the recommendation of the supervisor. A ***further 4*** subjects (optional subjects) may be chosen freely by the student, with the agreement of the supervisor, from any of the subjects announced by the doctoral school.

In order to ensure the success of the doctoral program and the doctoral thesis, during the first eight semesters of the program, the student is ***required*** *to write a* ***mandatory report*** *(semester research and study report) every semester on the progress of his/her research topic, which is evaluated by the Doctoral School in the manner specified in its regulations. The report must also be presented orally.*

The recommended order of admission of the subjects and the *order of the compulsory reports are* shown in the table below:

Subject	SEMESTER							
	1st	2nd	3rd	4th	5th	6th	7th	8th
Basic subject I in safety and security sciences								
Basic subject II in safety and security sciences								
Research topic related basic subject I								
Research topic related basic subject II								
Optional subject 1								
Optional subject 2								
Optional subject 3								
Optional subject 4								
Research and study report								

1.3. Subjects of the doctoral school[1]

The subjects that the doctoral school wishes to offer and their instructors:

Basic courses (subjects) in the field of safety and security science:

The place and role of security science in the system of sciences
Zoltán Rajnai

Risk analysis using probabilistic methods
László Hanka

Publication standards, knowledge
Zoltán Rajnai

[1] The subjects are regularly updated on the website of the doctoral school.

Research topic related basic courses (subjects):

Global security threats and trends
Tibor Babos

The regulation and institutional framework of occupational safety and health in the European Union and Hungary
Gyula Szabó

Safety against brittle fracture
Anna Tünde Kovács

Central issues of European security
Tibor Babos

Introduction to vibration theory
Lívia Cvetityánin

Strongly non-linear vibrations
Lívia Cvetityánin

Weak non-linear vibrations
Lívia Cvetityánin

Fuzzy inference systems and their applications
Edit Laufer

Information security standard theories
András Kerti

Critical infrastructure protection research
Tibor Babos

Risk analysis methodology
András Kerti

Computer-aided design and safety engineering of advanced control systems
Róbert Szabolcsi

Transport safety
Judit Lukács

Critical infrastructures
Zoltán Rajnai

Qualitative research methodology and analysis
Anikó Kelemen-Erdős

Mathematical software applications
László Hanka

Modern Control Engineering in Mechatronics
Róbert Szabolcsi

Modern techniques and their engineering applications
Judit Lukács

Technical reliability
László Pokorádi

Analysis of degradation processes in structural materials
Anna Tünde Kovács

Model studies of operational processes
László Pokorádi

Automatic flight control of UAV/UAS systems
Róbert Szabolcsi

Criteria of the Ground/Air Maintenance of the UAV/UAS Systems
Róbert Szabolcsi

Flight Safety of the UAV/UAS Systems
Róbert Szabolcsi

1.4. Research topics of the doctoral school

The list of topics of the Doctoral School on Safety and Security Sciences is updated every semester on the website of the Hungarian Doctoral Council, new topics are announced, and previous topics are activated by the Doctoral School upon the request of the supervisors and with the approval of the Doctoral School Council. The current topic descriptions are available at the following link: https://doktori.hu/index.php?menuid=116&lang=HU&lid=116&lang=HU&tol=0&sb=0

1.5. The complex examination

(1) Completion of the complex examination is a prerequisite for the start of 2nd i.e. the research and dissertation phase of the training program, and is a summarizing, reviewing form of assessment of the knowledge acquired by the person participating in the doctoral procedure in the discipline.

(2) Admission to the complex examination shall be conditional on the completion of the 1st i.e. the training and research phase of the training program **at least 90 credits in** the **first four semesters**, including all the "training credits" provided for in the curriculum (except for students preparing individually, whose student status is established by applying for the complex examination and passing it).

(3) The complex examination must be taken in public before a committee. The committee shall consist of at least three members. At least one third of the members of the committee shall not be employed by the institution operating the doctoral school. The chairperson of the committee may be a university professor, habilitated associate professor, habilitated college professor, Professor Emeritus or researcher with the title of Doctor of the Hungarian Academy of Sciences. All members of the committee must hold an academic degree. The supervisor of the doctoral student taking the examination may not be a member of the committee (Article 12/A (2) of Act No. 387/2012 Coll.).

(4) The committee for the complex examination shall be approved and appointed by the Doctoral and Habilitation Council for Science and Technology (MTTDHT) on the recommendation of the Doctoral School Council (DIT) in the case of engineering and natural sciences, and by the Doctoral and Habilitation Council of Óbuda University (EDHT) in the case of the arts and social sciences.

(5) The complex examination consists of two parts:

a) the theoretical part, during which the doctoral student shall demonstrate his/her knowledge of the literature of the relevant discipline, art, and current theoretical and methodological knowledge, and

b) from the report on the research and study progress (Article 12/A (3) of the Act 387/2012 Coll.).

(6) In the theoretical part of the complex exam, the candidate shall take examinations in at least two and at most three subjects/topics, the list of subjects/topics being specified in the training plan of the doctoral school. The theoretical part of the examination may include a written part. In the second part of the complex exam, the candidate will take a presentation on his/her knowledge of the literature, his/her research and creative work, his/her research plan for the second phase of doctoral training, and the timetable for the preparation of the dissertation and the publication of the results. The supervisor should have the opportunity to assess the candidate in advance in writing and/or at the examination.

(7) The committee shall assess the theoretical and dissertation parts of the examination separately. A record of the complex examination shall be drawn up in accordance with Annex D7). The performance of the candidate shall be assessed by the members of the committee by secret ballot of 1-2-3-4-5 points per subject, considering the opinion and recommendation of the examiner of the subject/theme. The dissertation part is evaluated by secret ballot by the members of the committee with a score of 0-1 (no-yes). The theoretical part of the complex examination is successful if the candidate has obtained at least 2/3 of the points available per subject/topic area. The dissertation part of the complex examination is successful if the candidate has obtained more than 50% of the 'yes' votes. The complex examination is successful if the candidate has passed both parts.

(8) The doctoral student may repeat the failed complex exam (part of the exam) once, in the same examination period (Article 12/A (4) of Decree 387/2012).

(9) The result of the examination shall be announced on the day of the last part of the examination. The complex exam shall be graded in two grades, passed or not passed (§ 12/A (5) of Decree No 387/2012 Coll.)

The Curriculum of the doctoral school has been approved by the Doctoral School Council.