ÓBUDAI EGYETEM
ÓBUDA UNIVERSITY

CURRICULUM OF THE DOCTORAL SCHOOL ON SAFETY AND SECURITY SCIENCES

BUDAPEST, 2025

(Effective November 27, 2025)

Doctoral School on Safety and Security Sciences
Training plan

Security science is an engineering discipline in which research and development tasks motivated by real-world needs can be carried out through the high-level integrated application of multiple scientific disciplines. The aim of the new scientific results emerging from this research is to ensure that a critical system behaves as desired, *even in the event of system component failure, external disturbances, or dysfunctional cooperation between components*.

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

The interpretation of security has become a serious social, economic, and political factor in our day. At the international level, NATO and the European Union have also developed their concepts and regulatory ideas in this regard. Today, maintaining safe living and working conditions and sustainable security have also become issues of state governance.

In security science, *beyond the general need for universal scientific knowledge*, this paradigm shift has given rise to new, specific research needs, which have also been reflected in the international scientific community. The scientific research and professional public life system provides a natural framework for this. Without claiming to be exhaustive, we highlight a few leading professional and scientific organizations, impact factor journals, and annual scientific conferences:

- *organizations* (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),
- *impact factor journals* (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 safety science worldwide. They recognized early on that safety can only be addressed in a complex manner, and that natural needs and expectations can only be met through the integration of knowledge. To this end, it is necessary to combine the relevant disciplines. This is also reflected in the master's and doctoral programs in safety engineering offered by the institutions concerned, as shown by the following international examples:

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

- *Doctoral programs*: University of London (multiple PhD programs); University of Manchester (biometric identification and applications); University of Stavanger (risk management and social security from a multidisciplinary perspective); Texas Tech University (multiple PhD programs); Northcentral University (computer and information security); UCCS University of Colorado (multidisciplinary research in the fields of physical, national and IT security); University of Alabama at Birmingham, Auburn University (occupational safety and ergonomics); Kyushu University (the relationship between materials, material structures, safety and reliability); Wuhan University of Technology (PhD in security engineering).

The response of the relevant players in Hungarian higher education has been far from rapid: b There is currently no doctoral program in security science at any institution. Therefore, it is clearly justified and*, in* fact, necessary, *taking into account international trends and economic and social processes in Hungary*, for Óbuda University, which is most involved in the training of safety engineers, to respond to the paradigm shift and launch a training program for scientists capable of conducting creative research into the complex problems of safety, at a level exceeding the basic and master's degrees in safety engineering, to launch a training program for scientists capable of conducting creative research into the complex problems of security, the first of its kind 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, through the synergistic and creative application of their acquired knowledge, are able to independently solve research and development tasks based on real industrial needs. In this way, the boundaries between previously sharply separated disciplines are blurred, and the project-oriented approach required to solve practical tasks generates synergies between disciplines, resulting in a novel "knowledge triangle" in security science.

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 for core members, supervisors, lecturers, and guest lecturers to not only strengthen their own research topics, but also to complement each other in generating new interdisciplinary research topics and to achieve significant results by international standards with the talented young people working on them.

1.1. Structure of the doctoral school's training program

In accordance with the principles outlined above, the Doctoral School builds on safety science-oriented disciplines such as engineering modeling and simulation, robotics, mechatronics, control theory, computer science, intelligent engineering systems, computer-aided manufacturing, etc. It uses their tools to solve problems, but differs from them in that the goal of its analyses and method developments is to effectively solve a given safety science problem. This requires essential knowledge of the specific field of application, as well as intensive and in-depth cooperation with the relevant fields/experts.

The doctoral school focuses on the following topics of paramount importance that often come to the fore in solving scientific problems raised by industry:

- security science modeling (security science, security risk modeling and analysis; intelligent methods in security science),
- protection of critical infrastructures (security of critical systems; critical information infrastructures; information and communication networks),
- information system security and reliability (information protection; information security management systems; visual information; biometric identification),
- safety issues in human-machine systems (safety of human-robot interaction; failure dynamics in human-machine systems; safety issues in mobile robots),

- safety issues in human-environment systems (electronic surveillance and control systems; complex object protection systems; mechanical and human protection; accident risks; hazardous waste; use of non-lethal weapons),
- operation and operational safety (mechanical, electronic, and mechatronic equipment; emergency management).

Óbuda University has significant intellectual resources and domestic and international research (academic and industrial) collaborations in the above areas.

1.2. Structure of the doctoral school's educational program

The doctoral program consists of 8 semesters. During the 8 semesters, students must earn 240 credit points to obtain their degree, as follows:

- Courses: at least ***48 credits***, with ***6 credits*** per course.
- Semesterly (written and oral) research reports:
    - ***Semesters*** 1***-4: 8-8 credits***
    - ***Semesters 5-8: 15-15 credits*** (total for 8 semesters: *92 credits*).
- Publications related to the research topic: ***at least 75 credits***.
- Active participation in a research project: ***6-10 credits/project***.
- Participation in teaching: ***maximum 60 credits*** (no mandatory minimum), 1 contact hour per week (1x45 minutes) = 2 credits.
  Doctoral students may receive a maximum of 5 teaching credits per semester for their teaching activities during the first four semesters of their training, and a maximum of 10 credits per semester during the fifth to eighth semesters of their training. Teaching activities shall be certified by the deputy dean of education of the relevant faculty or by an official in a corresponding position (e.g., in the case of foreign education).

According to the credit regulations, students must take ***a minimum of eight (8)*** courses as part of their training and pass the exams. Of the eight ***subjects,*** four ***are compulsory*** foundation subjects related to the doctoral topic, of which two ***subjects*** *(category of foundational subject in security science)* serve to lay the foundations for *security science* and ***two subjects*** serve to lay the foundations for *the research topic* (*category of foundational subject for the research area*). These four subjects are approved by the Doctoral School Council (DIT) on the recommendation of the supervisor. The student may freely choose a ***further four*** subjects (elective subjects) from among all the subjects offered by the doctoral school, with the agreement of the supervisor.

In order to ensure the success of the doctoral program and the doctoral dissertation, during the first eight semesters of the program, the student must write a ***mandatory report*** *(semester research and study report) every semester on the progress of their research topic, which is* *evaluated by the Doctoral School with credit points as specified in its regulations. The report must also be presented orally.*

The recommended course structure and *the order* of *mandatory reports* are shown in the table below:

Subject	Semester							
	1	2	3	4	5.	6.	7.	8.
Foundational subject in security science I.	X							
Foundational subject in security science II.	X							
Foundational subject for the research area I.		X						
Foundational subject for the research area I.		X						
Elective subject-1.			X					
Elective subject-2.			X					
Elective subject 3.				X				
Elective subject 4.				X				
Semester-end research and study report	X	X	X	X	X	X	X	X

1.3. Subjects of the doctoral school[1]

Subjects to be offered by the doctoral school and their instructors:

<u>Foundational subject in security science:</u>

Areas of security technology and their network
Lajos Berek

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

Physical protection systems
Arnold Őszi

Risk assessment with probabilistic methods
László Hanka

[1] The items are regularly updated on the BDI website!

Object protection
Lajos Berek

Publication standards, knowledge
Zoltán Rajnai

Scientific research methodology
Lajos Berek

<u>Foundational subject for the research area:</u>

Global security threats and trends
Tibor Babos

Industrial security in the operation of military critical infrastructure elements
Norbert Daruka

Regulation and institutional system of occupational safety in the European Union and Hungary
Gyula Szabó

Safety against brittle fracture
Tünde Anna Kovács

Materials science – special materials
Mihály Réger

Material Selection and Investigations for Safety-Critical Constructions
Richárd Horváth

Motion analysis in biomechanics
István Bíró

Empirical models, mathematical modeling
Richárd Horváth

Energy security
Péter Kádár

Strong nonlinear oscilliator
Lívia Cvetityánin

Fuzzy inference systems and their applications
Edit Laufer

Weak nonlinear oscilliator
Lívia Cvetityánin

Information security management systems
Pál Michelberger

Information security standard theories
András Kerti

Defence characteristics of large industrial investments
Tamás Berek

Control system design using MATLAB
Róbert Szabolcsi

Disaster management IT systems
Dóra Maros

Cybersecurity
Lajos Muha

Kinematics and kinetics
István Bíró

Risk analysis methodology
András Kerti

Modern technical diagnostics
József Zoltán Szabó

Road safety
Judit Lukács

Different aspects of critical infrastructure protection
János Besenyő

Research on critical infrastructure protection
Tibor Babos

Critical infrastructures
Zoltán Rajnai

Qualitative research methods and analysis
Anikó Kelemen-Erdős

Application of mathematical softwares
László Hanka

Mechanical protection
Lajos Berek

Metrology and data evaluation
Ágota Drégelyi-Kiss

Modern control engineering in mechatronics
Róbert Szabolcsi

Modern techniques and their engineering applications
Judit Lukács

Technical reliability
László Pokorádi

Theory and practice of precision explosives
Norbert Daruka

Theory and practice in the production, use and handling of explosives materials and products
Norbert Daruka

Methods and tools for the detection and defusing of explosive devices
Norbert Daruka

Protection of special objects
Tamás Berek

Damage analysis of the structural materials
Tünde Anna Kovács

Technical and technological aspects of fire safety
Rudolf Nagy

Automatic Flight Control Systems of the UAV/UASs
Róbert Szabolcsi

Model studies of maintenance processes
László Pokorádi

1.4. Research topics of the doctoral school

The list of topics for the Doctoral School on Safety and Security Sciences is updated every semester on the website of the Hungarian Doctoral Council (ODT), new topics are announced, and previous topics are activated by the Doctoral School at the request of the supervisors with the approval of the BDI DIT. The current topics 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 comprehensive examination

Doctoral Government Decree 12/A. §

(1) The comprehensive examination shall be organized in accordance with the principles laid down by the National Doctoral Council, in accordance with Section 72 (5) of the Nftv. The requirements of the comprehensive examination shall be published when the doctoral program is announced, as specified in the operating rules of the doctoral school.

(2) The comprehensive examination shall be taken publicly before a committee. The committee shall consist of at least three members. With the exception of doctoral schools offering exclusively religious education, at least one-third of the committee members shall not be employed by the institution operating the doctoral school. The chair of the committee may be a university professor, a habilitated associate professor, a habilitated college professor, a professor emeritus, or a lecturer or researcher holding a doctorate from the Hungarian Academy of Sciences. All members of the committee must hold an academic degree. The supervisor of the doctoral candidate taking the examination may not be a member of the committee.

(3) The comprehensive examination consists of two parts:

a) a theoretical part, during which the doctoral candidate demonstrates their knowledge of the relevant scientific or artistic literature and their current theoretical and methodological knowledge, and

b) a report on scientific or artistic progress.

(4) The doctoral student may retake the complex examination once during the same examination period if they fail.

(5) Minutes shall be taken of the comprehensive examination. The results of the examination shall be announced on the last day of the examination period. The comprehensive examination shall be graded on a two-point scale, with a pass or fail rating.

EDHSZ Section 19

(1) Passing the comprehensive exam is a prerequisite for beginning the research and dissertation phase. It is a summary and review of the knowledge acquired by the doctoral candidate in their field of study.

(2) Admission to the comprehensive examination is conditional on the acquisition of at least 90 credits during the training and research phase of the doctoral program (first four semesters), which includes all "training credits" specified in the DI training plan (except for those preparing for a doctoral degree on an individual basis, whose student status is established upon application for the comprehensive examination and successful completion of the examination, and who are awarded 120 credits).

(3) The complex examination committee shall be approved and appointed by the MTTDHT in the case of technical and natural science training, and by the TÁMDHT in the case of arts and social science training, upon the recommendation of the doctoral school council. (4) In the theoretical part of the comprehensive examination, the examinee shall take an examination in at least two and at most three subjects/topics, the list of which is included in the doctoral school's training plan. With the permission of the doctoral school council, a comprehensive examination may also be taken in a subject not included in the list. The theoretical examination may also include a written part. In the second dissertation part of the comprehensive examination, the examinee gives an account of their knowledge of the literature in the form of a presentation, reports on their research and creative achievements, and presents their research plan for the second stage of doctoral training, as well as the schedule for the preparation of the dissertation and the publication of the results. The supervisor must be given the opportunity to evaluate the candidate in advance in writing and/or during the examination.

(5) The committee shall evaluate the theoretical and dissertation parts of the examination separately. Minutes of the comprehensive examination shall be taken in accordance with Annex D7). The committee members shall evaluate the candidate's performance on a subject-by-subject basis by secret ballot, awarding 0-1 points (no-yes), taking into account the opinion and recommendation of the examiner for the subject/topic.

The dissertation part is evaluated by the committee members by secret ballot with 0-1 points (no-yes). The theoretical part of the comprehensive exam is successful if the candidate has received at least 2/3 of the available points for each subject/topic.

The dissertation part of the comprehensive exam is successful if the candidate receives more than 50% of the yes votes. The comprehensive exam is successful if the candidate passes both parts.

The Doctoral School Training Plan has been approved by the Doctoral School Council (DIT).