

# **TRAINING PROGRAM OF THE DOCTORAL SCHOOL OF CHEMICAL ENGINEERING AND MATERIALS SCIENCES AT UNIVERSITY OF PANNONIA**

## **Objectives of the Program**

The Doctoral School of Chemical Engineering and Materials Sciences (hereinafter: CEMSDS) trains professionals who can perform independent, creative work based on critical thinking in the most important fields of chemical engineering and materials science within the requirements of the market economy. The objective of the training is to establish the foundation for obtaining a doctoral degree.

## **Main Characteristics of the Program**

Doctoral training comprises regular study, research, and reporting activities, which include fulfilling the obligations prescribed in the University's Doctoral Regulations. In the doctoral training at CEMSDS, the award of doctoral degrees is conditional on the completion of study obligations within 6 semesters for those who commenced their studies before September 1, 2016, and within 8 semesters for those who enrolled after September 1, 2016.

Study credits can be obtained by completing subjects, research tasks, and teaching tasks. Considering the characteristics of doctoral training, which requires significantly more individual study compared to graduate education, 1 contact hour per week in doctoral training corresponds to 2 study credits (SC).

The study credit value for research activities and research results is calculated based on the average time commitment of a student with average abilities.

## **Structure of the Program**

Doctoral training is divided into three main components: study activities, research activities, and teaching activities. Teaching activity is not a mandatory part of the training.



## **II. Optional Subjects Recommended by Specialization: Required minimum: 14 study credits**

### ***VM-1: Material analysis methods and surface chemistry***

<b>Course Name</b>	<b>Lecturer</b>	<b>Hours</b>	<b>SC</b>
IR and Raman Spectroscopy	Balázs Zsirka	2+0+0 K	4
Modern surface analysis methods	János Kristóf	2+0+0 K	4
Nuclear measurement technology	Edit Tóth-Bodrogi	2+0+0 K	4
Rheological studies	László Bartha Roland Nagy	2+0+0 K	4
X-ray diffraction	Éva Kristófné Makó	1+0+1 K	4
Computer microscopy	Miklós Jakab	1+0+1 K	4
Determination of mechanical properties of solid bodies	Imre Timár	2+1+0 K	6
Thermal analysis	János Kristóf	2+0+0 K	4
Mechanics of high power density drives	Attila Csobán	2+0+0 K	4

### ***VM-2: Process engineering sciences***

<b>Course Name</b>	<b>Lecturer</b>	<b>Hours</b>	<b>SC</b>
Data Modeling Methods	János Abonyi	2+0+0 K	4
Process Synthesis and Optimization	Béla Lakatos Alex Kummer	2+0+0 K	4
Management/Control algorithms	Lajos Nagy	2+0+0 K	4
Modern technology development	Tibor Chován Attila Egedy	2+0+0 K	4
Modeling and Simulation (Integrated Course)	Sándor Németh Ágnes Takács-Bárkányi	3+0+0 K	6

### ***VM-3: Intelligent materials and technologies***

<b>Course Name</b>	<b>Lecturer</b>	<b>Hours</b>	<b>SC</b>
Measurement methods for soft smart materials	Barnabás Horváth	2+0+0 K	4
Soft intelligent materials and their applications	István Szalai	2+0+0 K	4
Modern optics	Zoltán Gugolya	2+0+0 K	4
Optimal scaling of technology systems (material, energy and cost saving)	Imre Timár	2+0+0 K	4

### ***VM-4: Procedures and material systems from ceramic industry***

<b>Course Name</b>	<b>Lecturer</b>	<b>Hours</b>	<b>SC</b>
Composite materials	András Kovács	2+0+0 K	4
Modern technical ceramics	Tamás Korim	3+0+0 K	6
Modern technical glasses	Tamás Korim	2+0+0 K	4
Nanostructured metals, ceramics, plastics	János Szépvölgyi	3+0+0 K	6
Silicate chemistry	Margit Eniszné Bódogh	2+0+0 K	4

### ***VM-5: Up-to-date Chemical Unit Operations***

<b>Course Name</b>	<b>Lecturer</b>	<b>Hours</b>	<b>SC</b>
Energetics	Zoltán Hodai	2+0+0 K	4
Modern liquid separation operations	László Hanák	2+0+0 K	4
Reaction Technique	Róbert Bocsi	2+0+0 K	4
Transport Theory	Dóra Pethő	2+0+0 K	4

**VM-6: Environmental engineering technological systems**

Course Name	Lecturer	Hours	SC
Life cycle analysis	Endre Domokos	0+2+0 Gy	4
Pharmaceutical chemistry and syntheses	Rita Skodáné Földes	3+0+0 K	6
Waste management	Róbert Kurdi	2+0+0 K	4
Catalysis	Tatjana Juzsakova	2+0+0 K	4
Environmental impact assessment, auditing	Tatjana Juzsakova	2+0+0 Gy	4
Environmental management systems	Viola Somogyi	2+0+0 K	4
Air quality protection	Tatjana Juzsakova	2+0+0 K	4
Membrane separation processes in environmental protection	Katalin Bélafiné Bakó	2+0+0 K	4
Ecological risk assessment	Nóra Kováts	2+0+0 K	4
Radioecology	Edit Tóth-Bodrogi	2+0+0 K	4
Wastewater treatment technologies	Viola Somogyi	2+0+0 K	4
Soil contamination, damage prevention	Balázs Zsirka	2+0+0 K	4
GIS applications	Endre Domokos	0+2+0 Gy	4

**VM-7: Process and Products of the Hydrocarbon Processing Industries**

Course Name	Lecturer	Hours	SC
Chemistry and technology of lubricants	Roland Nagy	2+0+0 K	4
Modern engine and jet engine fuels	Jenő Hancsók	2+0+0 K	4
Petroleum industry equipment and scaling	Zoltán Varga	2+0+0 K	4
Polymer chemistry and technology	Norbert Miskolczi	2+0+0 K	4
Hydrocarbon industrial catalytic processes	Jenő Hancsók	2+0+0 K	4

**VM-8: Molecular and nanotechnologies**

Course Name	Lecturer	Hours	SC
Analytical system biology	András Guttman	2+0+0 K	4
Fundamentals of materials	István Bársony	2+0+0 K	4
Bioellipsometry	Péter Petrik	2+0+0 K	4
Structure and function of biological macromolecules	Ferenc Vonderviszt	2+0+0 K	4
Electronmicroscopy in materials science	Béla Pécz	2+0+0 K	4
Surface chemistry in biosensors	Sándor Kurunczi	2+0+0 K	4
Glycomics	András Guttman	2+0+0 K	4
Integrated microsystems	István Bársony	2+0+0 K	4
Ion beam characterization and material modifications	Miklós Fried	2+0+0 K	4
Label-free optical biosensors and their applications	Róbert Horváth	2+0+0 K	4
Up-to-date separation methods in biotechnology	Hajnalka Jankovics	2+0+0 K	4
Quantum chemistry I.	György Lendvay	2+0+0 K	4
Quantum chemistry II.	György Lendvay	2+0+0 K	4
Nanoscale physics	Miklós Fried	2+0+0 K	4
Particulate systems of controlled release	Tivadar Feczkó	2+0+0 K	4

**VM-9: Biotechnology**

VMADI Doctoral and Habilitation Council approved: February 4, 2026.  
Effective date: Valid until withdrawal.

Course Name	Lecturer	Hours	SC
Bioreactors	Katalin Bélafiné Bakó	2+0+0 K	4
Enzymatic catalysis in non-conventional media	László Gubicza	2+0+0 K	4
Integrated systems in biotechnology	Katalin Bélafiné Bakó	2+0+0 K	4
Integrated systems in biotechnology	Katalin Bélafiné Bakó	2+0+0 K	4

### *VM-10: Analysis of Economic Processes*

Course Name	Lecturer	Hours	SC
Fundamentals of Quantitative Methods (to be completed in the 1 <sup>st</sup> semester)	Attila Katona	2+0+0 K	0
Advanced methods in quantitative research II. (Quantitative Methods I. is a prerequisite)	Zsolt Kosztyán	2+0+0 K	4
Academic writing	Mihály Görög	2+0+0 K	4
Quantitative analysis of economic networks	Zsolt Kosztyán	3+0+0 K	6

### **III. Elective courses:**

**Required maximum: 10 study credits**

Course list of specialisations + accepted courses from other doctoral schools

Course Name	Lecturer	Hours	SC
Fundamentals of genetic engineering and protein engineering	Hajnalka Jankovics	2+0+0 K	4
Modern instrumental analytical methods for environmental protection	János Kristóf	2+0+0 K	4
Adsorption and drying	Róbert Bocsi	2+0+0 K	4
Functional materials for alternative energy sources	Tamás Korim	2+0+0 K	4
Material transformations and syntheses under special circumstances	János Szépvölgyi	2+0+0 K	4
Nuclear Energetics applications	Edit Tóth-Bodrogi	2+0+0 K	4
Bioseparation	László Hanák	2+0+0 K	4
Biosensors and nanobiosensors	Hajnalka Jankovics	2+0+0 K	4
Digital manufacturing	István Gábor Gyurika	2+0+0 K	4
Separation methods	Krisztián Horváth	2+0+0 K	4
Production of proteins, their applications; cell-free protein synthesis	Hajnalka Jankovics	2+0+0 K	4
Investigation of surfaces and thin films with polarized light	Miklós Fried	2+0+0 K	4
Capillary electrophoresis	Gábor Járvas	2+0+2 K	8
Techniques for repairing damage	Erzsébet Horváth	2+0+0 K	4
Chemometrics	Tamás Pap	2+0+0 K	4
Ceramic technology	Tamás Korim	2+0+0 K	4
Combined operations	Zoltán Hodai	2+0+0 K	4
Technology of binders	Tamás Korim	2+0+0 K	4
Special machining procedures	István Gábor Gyurika	2+0+0 K	4
Mechanochemical Processes	Éva Kristófné Makó	2+0+0 K	4
Microfluidics	Gábor Járvas	2+0+2 K	8
Highly selective organo-chemical syntheses	Gergely Farkas	2+0+0 K	4
Numerical methods in engineering practice	Krisztián Horváth	2+0+0 K	4
Preparative liquid chromatography	László Hanák	2+0+0 K	4
English for engineers	Katalin Bélafiné Bakó	2+0+0 K	4
Sintering Processes	Margit Eniszné Bódogh	2+0+0 K	4
New analytical trends in glycomics	András Guttman	2+0+0 K	4
Glass Chemistry	Margit Eniszné Bódogh	2+0+0 K	4

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Glass Technology	Tamás Korim	2+0+0 K	4
Modern X-ray fluorescence spectrometry and its application	Éva Kristófné Makó	2+0+0 K	4
Molecular biological tools of industrial biotechnology	Hajnalka Jankovics	2+0+0 K	4

A minimum of 48 study credits must be completed by taking courses.

## 2. Research program

The research program involves conducting scientific research necessary for preparing the doctoral dissertation under the supervision of a supervisor, with continuous assessment. During research work, the doctoral candidate must master the application of scientific methods, achieve significant scientific results, and demonstrate these through scientific publications and presentations, thereby proving the ability to solve scientific problems independently.

- The doctoral candidate must report on the research work at least semi-annually.
- An important part of the research program is encouraging proper documentation of research results, for which separate study credits may be awarded.

### Study Credits Awarded for Achievements in the Research Program (SC):

Textbook, teaching aid	15 SC/pcs* participant share
Article in a referenced international journal (first author)	30 SC/pcs
Article in a referenced international journal (co-author)	25 SC/pcs
Article in a foreign language non-referenced journal (first author)	15 SC/pcs
Article in a foreign language non-referenced journal (co-author)	10 SC/pcs
Article in a Hungarian journal	8 SC/pcs
Poster in Hungarian	2 SC/pcs
Presentation in Hungarian with full-text publication	5 SC/pcs
Presentation in Hungarian with an abstract publication	3 SC/pcs
Poster in a foreign language	5 SC/pcs
Presentation in a foreign language with full-text publication	15 SC/pcs
Presentation in a foreign language with an abstract publication	10 SC/pcs
Patent	20 SC/pcs *participant share
Semester report (with written material, accepted with evaluation)	10 SC/pcs
Final report	10 SC
Research report, participation in study	6 SC/pcs * participant share
SSC / Thesis supervision	4 SC/pcs
SSC / Thesis co-supervision	2 SC/pcs

A minimum of 75 study credits must be completed in the research program.

### **3. Teaching program**

One objective of doctoral training is to ensure succession in university teaching staff. Performance of teaching tasks - according to Government Decree 51/2001 (IV.3) § 16 (1) - may not constitute part of the doctoral candidate's study obligations, but the doctoral student may be required to perform teaching work corresponding to 20% of the weekly full-time workload. A maximum of 45 SC can be awarded for teaching activities performed by the doctoral candidate. In the teaching program, doctoral candidates participate by conducting seminars and laboratory exercises based on a contract with the student. Conducting 1 contact hour per week, totalling 14 contact hours per semester, represents 2 study credits for the doctoral candidate. Teaching activity is certified at the end of each semester by the head of the organizational unit.

#### **Academic and Examination Regulations at CEMSDS**

- (1) The duration of fulfilling study obligations prescribed in the Doctoral Rules and receiving doctoral scholarship in organized doctoral training is a maximum of 3 years (36 months) for those who started the training before September 1, 2016, and 4 years (48 months) for those who started their studies after September 1, 2016.
- (2) The university may authorize interruption of the study period (for those who started the training before September 1, 2016) a maximum of three times, totalling three years (leave of absence). For those who started their studies after September 1, 2016, training may be interrupted twice, for a maximum of two semesters. The first request must be accepted. State scholarships are not disbursed during the suspension of student status.
- (3) Participants in organized training may pursue their studies at CEMSDS either as scholarship or tuition-paying students.
- (4) The admitted doctoral candidate prepares, in the first month of training and in agreement with the supervisor, a study and research plan, which is submitted to the DDHC (Disciplinary Doctoral and Habilitation Council) for approval.
- (5) The admitted doctoral candidate enrolls before each semester according to the procedures published by the administrative office.
- (6) The doctoral candidate enrolls each semester in courses offered according to the study plan. Courses include both mandatory and elective courses.
- (7) Announced courses are delivered according to the syllabus in the curriculum as specified in the announcement issued by CEMSDS at the beginning of the semester. The announcement must include materials for individual study, consultation times and topics, course completion requirements (tests, individual assignments, etc.), and examination methods.
- (8) The doctoral candidate may participate in part-time training abroad. The doctoral candidate may participate in part-time training based on a work program approved by the supervisor that ensures the validity of the given study period. The duration of part-time training abroad counts toward the doctoral training period, and student status is not suspended. Recognition of foreign study trips as part-time training may be authorized by the DS Director upon the supervisor's supportive recommendation.
- (9) The DS Director decides, upon request, whether courses completed at other doctoral schools may be accepted as elective courses.
- (10) The doctoral candidate is required to take examinations in enrolled courses.
- (11) Examination grades: excellent (5), passed (3), failed.
- (12) Failed examinations may be retaken once.

- (13) Completion of examinations and fulfillment of research requirements must be certified.
- (14) The next semester may only be commenced upon completion of the previous semester.
- (15) During the 36-month study period, 180 SC must be completed for those who started their studies before September 1, 2016, while after that date, completion of 240 SC in 48 months is expected.
- (16) Completion of doctoral training is indicated by a certificate of completion (pre-degree certificate), which certifies that the doctoral candidate has fully fulfilled all study and examination requirements prescribed by CEMSDS doctoral training.
- (17) For students who started their studies after September 1, 2016, the training is divided into two phases („training and research phase” and „research and dissertation phase”). In the training and research phase (first 4 active semesters), SC can be earned for acquiring knowledge, completing course requirements, research work, and teaching tasks. At the conclusion of the training and research phase (end of the 4th semester) - and as a prerequisite for commencing the research and dissertation phase - a comprehensive examination must be taken, which assesses academic and research progress. In the research and dissertation phase of training, SC can be earned through research activities. After earning the prescribed SC, the institution issues a certificate of completion (pre-degree certificate) to the doctoral candidate.

## **Course of Doctoral Training**

### **1. Fulfillment of Study Obligations by Students in Organised Training**

#### **1.1. Work Plan**

Students' work plans must be prepared in the first semester of organized training with the assistance of the supervisor. The work plan is approved by the DDHC and must contain the courses the student intends to enroll in according to the study program.

The work plan must be submitted:

- Electronically to the DS secretary
- In writing – validated with the student's signature and the supervisor's supporting signature – to the Directorate of Academic Affairs

The work plan is approved by the DDHC no later than the beginning of the student's second study semester.

#### **1.2. Fulfillment of Study Obligations**

The student coordinates with the course instructor regarding enrollment in courses specified in the work plan, and enrolls after the course is announced. Course completion is certified by the instructor through entry in the NEPTUN system.

Deviation from courses specified in the work plan is possible during studies. New courses to be enrolled must be selected according to the procedure specified for the original work plan. Changes may be requested through a request submitted to the DDHC, modifying the original work plan. Work plan modifications are approved by the DDHC no later than the beginning of the study semester following submission of the student request.

For training starting before September 1, 2016, the work plan covers 36 months, while for two-phase training starting after September 1, 2016, separate work plans must be prepared for both (24-month) phases, of which only the first phase contains a study plan. The work plan for the second phase is part of the comprehensive examination.

Beyond courses available at the University of Pannonia, we encourage students to participate in intensive scientific schools organized by other domestic and international institutions. The DDHC determines credits awarded for completing schools within the DS subject area on a case-by-case basis.

### 1.3. Research work, Reports

The doctoral candidate's most important activity is scientific research. The student conducts research independently under the supervisor's guidance and assistance. Results are presented at relevant conferences and published in quality journals with as much independence as possible. Credits awarded for publications and presentations are contained in the table found in the Training Program.

The doctoral candidate presents oral progress reports on work twice annually. Semi-annual reports are worth 10 study credits.

The doctoral candidate completes an evaluation form each semester, recording study credits earned through academic, research, and teaching activities.

An evaluation form must be submitted:

- electronically – together with necessary attachments – to the DS Secretary,
- in writing – validated with the student's signature and the supervisor's certifying signature – to the DS Secretary, and to the Directorate of Academic Affairs following the DS Director's supporting signature.

### 1.4. Pre-degree certificate

For training starting before September 1, 2016, the prerequisite for obtaining the pre-degree certificate is successful completion of the final report and earning at least 180 credits according to requirements. For training starting after September 1, 2016, the prerequisite for obtaining the pre-degree certificate is earning at least 240 credits according to requirements, plus fulfilling the language requirements necessary for degree conferral.

To obtain the pre-degree certificate, a request must be submitted:

- electronically to the DS Secretary,
- in writing – validated with the student's signature and the supporting signatures of the supervisor and DS Director – to the Directorate of Academic Affairs.

## 2. Actions Leading to Obtaining the PhD Degree

For training starting before September 1, 2016, the doctoral degree may be obtained following doctoral training within a separate degree conferral procedure. The person participating in the doctoral degree conferral procedure is the doctoral candidate. The application for the degree conferral procedure may be submitted within three years from issuance of the pre-degree certificate. If the doctoral student commences the degree conferral procedure within the training period, they are simultaneously both a student and a doctoral candidate. Before September 1, 2016, those who did not participate in doctoral training but prepared individually for degree conferral could also be doctoral candidates. Doctoral candidate status terminates upon conclusion of the degree conferral procedure, or if the doctoral candidate did not submit the doctoral dissertation within two years from the date of establishing the legal relationship, or did not obtain the doctoral degree within three years.

For training and individual preparation starting after September 1, 2016, there is no doctoral candidate status; in this case, the doctoral student must submit the dissertation within three years following successful comprehensive examination.

## 2.1 Doctoral Comprehensive Examination

For training starting before September 1, 2016, or for individual preparatory doctoral candidates who commenced before this date, passing the doctoral comprehensive examination is part of the procedure aimed at obtaining the doctoral degree, which is a comprehensive, overview-type assessment of knowledge acquired in the scientific field of the person participating in the doctoral degree conferral procedure.

Prerequisites for registering for the comprehensive examination:

- For PhD students in organised training: obtaining the pre-degree certificate (successful completion of studies);
- Submitting a request for approval to participate in the doctoral comprehensive examination.

The doctoral comprehensive examination must be taken in one major subject and one minor subject. The doctoral candidate's examination subjects are approved by the DDHC based on the supervisor's or consultant's recommendation.

Application for the doctoral comprehensive examination may be requested by the student, preferably simultaneously with obtaining the pre-degree certificate (or afterward), in a "Application for the Comprehensive Examination". The request must specify the major and minor examination subjects chosen by the student.

The request must be submitted

- Electronically to the DS Secretary's email address, and
- in writing – validated with the student's signature and the supervisor's supporting signature – to the Doctoral Administrator of the Faculty of Engineering's Dean's Office.

The DDHC decides on the application for the doctoral comprehensive examination within 1 month from submission of the request.

Organization of the comprehensive examination:

- Evaluation of the comprehensive examination request, composition of the Examination Committee. The Examination Committee consists of a chair, two examiners, and two additional members. At least one-third of the Examination Committee consists of qualified external professionals. The DDHC requests the supervisor's opinion regarding examiner nominations. The Committee chair must be a university professor or professor emeritus of UP. The candidate's supervisor cannot be a Committee member. The Committee composition is approved by the DDHC, if necessary, through electronic voting. The decision is communicated to the student, their supervisor, and the Doctoral Office (FE Dean's Office).
- Selection of the comprehensive examination topics. The student contacts the examiners in order to define the subject areas of the comprehensive examination, and then begins preparation.
- Scheduling: The Doctoral Office administrator preliminarily coordinates a date with the members of the Comprehensive Examination Committee, and then notifies the committee, the candidate, and the supervisor by email about the agreed date of the examination.
- Technical organization of comprehensive examination. The Doctoral Office conducts the technical organization of the comprehensive examination (room, official notification of committee members, travel reimbursement, examination fees, announcement of examination on UP website).

For training or individual preparation starting after September 1, 2016, a comprehensive examination is not required for degree awarding, as the complex examination ensures

verification of the doctoral candidate's theoretical preparation.

## 2.2 Complex exam

The two subjects included in the complex examination - similar to the comprehensive examination - are selected from the DS mandatory or compulsory elective courses (one major and one minor subject) in a manner that connects to the doctoral candidate's research area and topic. To take the complex examination, the candidate must have at least 90 credits, of which a minimum of 48 are study credits. At the time of submitting the complex exam application, the candidate must have at least 50 credits.

To register for the complex examination:

- The registration form must be sent electronically and on paper – validated with the student's signature and the supporting signatures of the supervisor and DS Director – to the DS Secretary
- Registration must also be completed in the Neptun system

The complex examination consists of two parts:

- The theoretical part, during which the doctoral candidate demonstrates orientation in the relevant scientific field's literature and current theoretical and methodological knowledge, and
- the dissertation part, during which the candidate reports on their scientific progress in English

The examination committee evaluates the theoretical and dissertation parts separately. The complex examination is successful if both examination parts are successful. An unsuccessful theoretical examination may be retaken once during the examination period in the failed subject. The dissertation part of the examination cannot be repeated if unsuccessful. Minutes must be taken of the complex examination. The examination result must be announced on the date of the last examination part. The complex examination is graded on a two-level scale: passed or failed. Successful completion of the complex examination is a prerequisite for entering the second phase, but its result does not count toward the degree grade.

## 2.3 Preparation of the Doctoral Dissertation

For training starting before September 1, 2016, or for individual preparatory doctoral candidates who commenced before this date, a prerequisite for obtaining the doctoral degree is the submission of a dissertation written by the doctoral candidate. The doctoral dissertation must be submitted either simultaneously with the submission of the application for doctoral candidacy or within two years after the acceptance of the application.

For training or individual preparation starting after September 1, 2016, the doctoral student must submit the doctoral dissertation within three years following the complex examination. This deadline may be extended by a maximum of one year - according to the UDHC decision - in cases deserving special consideration, provided that the student cannot fulfill obligations arising from student status through no fault of their own due to childbirth, accident, illness, or other unexpected cause.

The dissertation may be submitted in a foreign language at the author's request, with DDHC consent. The most important results of the doctoral dissertation must be summarized in theses.

## 2.4 Preliminary Professional/Home Defense of the Doctoral Dissertation

To support the author, the dissertation - before its completion - must be submitted for review to a professionally competent forum.

Before the public review, the PhD student's workplace supervisor requests two external reviewers to evaluate the dissertation, based on the supervisor's recommendation. The workplace supervisor also requests the presiding chair of the professional review. Coordinating and organizing the home defense is the responsibility of the student and/or the supervisor.

Objections raised in the reviews and during the review are weighed at the author's discretion when preparing the final version of the dissertation. Minutes and an attendance sheet must be kept of the presentation, the debate, and the author's response.

## 2.5 Doctoral Defense

Prerequisite for registering for defense: preparation and submission of the dissertation and thesis booklet with necessary additional documents (copies of language examination certificates, article reprints, etc.) to the Doctoral Office. For training starting before September 1, 2016, the doctoral defense may be held after successful completion of the comprehensive examination.

Minimum publication requirements for submitting the dissertation are specified in the CEMSDS Rules and Regulations.

Organization and conduct of the doctoral defense:

- Submission of the application for admission to the defense and the thesis booklet in English and Hungarian versions to the Doctoral School.
- The Doctoral School Director evaluates the application, proposes reviewers and Defense Committee members, based upon the supervisor's opinion. Both reviewers must be qualified external professionals. The committee chair is a university professor or professor emeritus of the University of Pannonia. Committee members may not include co-authors of publications with the candidate.
- The DDHC approves the application, proposal for reviewers, and Committee members, if necessary, through electronic voting. The DS secretary notifies the candidate, their supervisor, and the Doctoral Office of the decision and the Defense Committee composition.
- The Doctoral Office sends the dissertation to the designated reviewers for review, coordinating with the DS secretary.
- Following receipt of reviews, the Doctoral Office administrator preliminarily coordinates the schedule with the Defense Committee members, then notifies the committee, candidate, and supervisor by email of the agreed defense date.
- The technical organization of the defense (room, presentation equipment, official notification of committee members, travel reimbursement, honorarium, announcement of defense on the University of Pannonia website) is the Doctoral Office's responsibility. The DS secretary ensures that the dissertation, thesis booklets, reviews, and responses are posted on the HDC website.
- Following the defense, based on the Committee's recommendation, the University Doctoral and Habilitation Council decides on conferral of the doctoral (PhD) degree.

**LIST OF COMPREHENSIVE EXAMINATION (COMPLEX EXAMINATION)  
SUBJECTS OF THE DOCTORAL SCHOOL OF CHEMICAL ENGINEERING AND  
MATERIALS SCIENCES**

**MAJOR SUBJECTS:**

- The basics of micro and nano detection
- Examination of material structure
- Material Science
- Bio-nanotechnology
- Process Engineering Sciences
- Functional micro- and nanoparticles
- Modern oil and petrochemical processes
- Modern chemical industry operations
- Environmental Engineering
- Special materials for mechatronic systems
- Technical biotechnology
- Radioisotopic techniques and their application
- Selected organic chemical technologies
- Advanced methods in quantitative research I.

**MINOR SUBJECTS BY RESEARCH SPECIALISATION:**

**Material analysis methods and surface chemistry**

- IR and Raman Spectroscopy
- Modern surface analysis methods
- Nuclear measurement technology
- Rheological studies
- X-ray diffraction
- Computer microscopy
- Determination of the mechanical properties of solid bodies
- Thermal analysis

**Process engineering sciences**

- Data Modeling Methods
- Process Synthesis and Optimization
- Management/Control algorithms
- Modern technology development
- Modeling and Simulation (Integrated Course)

**Intelligent materials and technologies**

- Measurement methods for soft smart materials
- Soft intelligent materials and their applications
- Modern optics
- Optimal scaling of technology systems (material, energy, and cost saving)

**Procedures and material systems of ceramic industry**

- Composite materials
- Modern technical ceramics
- Modern technical glasses
- Nanostructured metals, ceramics, plastics
- Silicate chemistry

**Up-to-date Chemical Unit Operations**

- Energetics
- Modern liquid separation operations
- Reaction Technique
- Transport Theory

**Environmental engineering technological systems**

Life cycle analysis  
Pharmaceutical chemistry and syntheses  
Waste management  
Catalysis  
Environmental impact assessment, auditing  
Environmental management systems  
Air quality protection  
Membrane separation processes in environmental protection  
Ecological risk assessment  
Radioecology  
Wastewater treatment technologies  
Soil contamination, damage prevention  
GIS applications

### **Process and Products of the Hydrocarbon Processing Industries**

Chemistry and technology of lubricants  
Modern engine and jet engine fuels  
Petroleum industry equipment and scaling  
Polymer chemistry and technology  
Hydrocarbon industrial catalytic processes

### **Molecular and nanotechnologies**

Analytical system biology  
Fundamentals of materials  
Bioellipsometry  
Structure and function of biological macromolecules  
Electronmicroscopy in materials science  
Controlled release of drug: theories and applications  
Surface chemistry in biosensors  
Glycomics  
Integrated microsystems  
Ion beam characterization and material modifications  
Label-free optical biosensors and their applications  
Up-to-date separation methods in biotechnology  
Quantum chemistry I-II.  
Nanoscale physics  
Particulate systems of controlled release

### **Biotechnology**

Bioreactors  
Enzymatic catalysis in non-conventional media  
Integrated systems in biotechnology  
Kinetics of complex enzymatic reactions

### **Analysis of Economic Processes**

Gazdasági hálózatok kvantitatív elemzése