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Doctoral degree regulations of the Department of Technology and Systems of the Graduate School for Applied Research in North Rhine-Westphalia

from 24.04.2023

Based on § 67b (3) and § 67 (3) of the Higher Education Act of the State of North Rhine-Westphalia (Hochschulgesetz – HG NRW) of September 16, 2014, as amended by the Act Amending the Higher Education Act of July 12, 2019 (GV. NRW. p. 377) and the Framework Doctoral degree regulations of the Graduate School for Applied Research in North Rhine-Westphalia of January 31, 2023 (RPO), the Department council of the Department of Technology and Systems has issued the following doctoral degree regulations:

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§ 1 Scope of application

(1) These doctoral degree regulations apply to the doctoral procedures carried out in the Department of Technology and Systems of the Graduate School for Applied Research in North

Rhine-Westphalia. Insofar as no provisions have been made in these doctoral degree regulations, the corresponding rules of the Framework Doctoral degree regulations of the Graduate School for Applied Research in North Rhine-Westphalia.¹

(2) If doctoral topics are cross-departmental, the doctoral examining committee of the department in which the doctoral candidate is enrolled is responsible, unless this is stipulated by other regulations. The supervisors, reviewers and members of the examination examining committee are appointed in such a way that the departments involved are appropriately represented.

§ 2 Conferral of doctoral degrees

(1) The department awards the following academic degrees in the Cyber Physical Systems doctoral program on the basis of successful completion of the doctoral examination:

1. If the subject matter is predominantly engineering science, the degrees
 - Doktor der Ingenieurwissenschaften (Doktor-Ingenieur – Dr.-Ing.)
 - Doktorin der Ingenieurwissenschaften (Doktor-Ingenieurin – Dr.-Ing.)
 - Doktor*in der Ingenieurwissenschaften (Doktor-Ingenieur*in – Dr.-Ing.)
2. If the subject matter is predominantly natural scientific, the degrees
 - Doktor der Naturwissenschaften (Doctor rerum naturalium – Dr. rer. nat.)
 - Doktorin der Naturwissenschaften (Doctor rerum naturalium – Dr. rer. nat.)
 - Doktor*in der Naturwissenschaften (Doctor rerum naturalium – Dr. rer. nat.)

The decision is made by the responsible doctoral examining committee.

§ 3 Purpose and form of the doctorate

(1) The doctorate serves as proof of the ability to carry out in-depth scientific work in one of the specialist areas of the Department of Technology and Systems. It is based on independent scientific work (dissertation) and an oral examination (disputation).

(2) The doctorate takes place within the framework of the doctoral program mentioned in § 2 (1). The achievements required within this framework must be completed and are therefore part of the requirements for admission to the doctoral procedure.

(3) Doctorates can also be carried out across departments. In this case, the applicable requirements for the composition of the supervisory team are regulated in § 7 of these regulations.

(4) Doctoral candidates may also perform the work to be completed in accordance with (2) in doctoral programs in other departments. The doctoral examining committee shall decide on the crediting of the work.

¹ The provisions in these regulations do not apply to cooperative doctoral procedures in which the procedure is conducted exclusively via the doctoral right of the university or another university authorized to award doctorates.

(5) The duration of the doctorate should not exceed five years. In justified cases, the doctoral examining committee may extend the period by one year three times. The application must be accompanied by a justification as well as a statement from the supervisors. Protection periods and leaves of absence in accordance with § 20 RPO are not counted towards the duration of the doctorate.

§ 4 Doctoral examining committee

(1) The composition, responsibilities and working methods of the doctoral examining committee are regulated in § 4 of the RPO.

(2) In order to simplify the procedure, the Doctoral Examining committee may delegate individual tasks to the Chairperson for execution in accordance with § 4 (1) RPO.

§ 5 Admission requirements

According to HG § 67 (4), access to the doctoral procedure is granted to those who hold

- (a) a degree following a relevant university course of study with a general standard period of study of at least eight semesters, for which a degree other than “Bachelor” is awarded, or
- (b) a degree from a relevant Master's degree program within the meaning of HG § 61 (2) sentence 2,

each with an overall grade of at least “good”.

Technical degree programs in computer science, electrical engineering, mechanical engineering or medical engineering are considered relevant. The doctoral examining committee may allow exceptions.

If the qualifying degree in accordance with § 5 RPO was obtained with a grade lower than “good”, the doctoral examining committee may exceptionally admit the applicant to the doctorate if two expert opinions from professors with a proven track record recommend the applicant.

Non-native German-speaking applicants who wish to complete their doctoral studies in German must provide proof of sufficient German language skills. The German language examination for university admission (DSH level 2), TestDaF level 4, Goethe-Zertifikat C1 or comparable certificates are generally considered sufficient. The same applies to non-native English-speaking applicants who wish to complete their doctoral studies in English. For these applicants, English language skills corresponding to level C1 of the Common European Framework of Reference for Languages (CEFR) are generally considered sufficient.

§ 6 Acceptance as a doctoral candidate

(1) Acceptance as a doctoral candidate is regulated in § 6 of the RPO.

(2) Acceptance is initially limited to five years and can be extended three times by one year upon application, provided that the supervisors of the thesis recommend and confirm, that the doctoral project can be successfully completed. In addition, protection periods according to § 20 RPO apply.

§ 7 Supervision

(1) Supervision is regulated in § 7 of the RPO.

(2) In the case of interdisciplinary doctoral projects, the supervisors are appointed in such a way that the disciplines involved are appropriately represented. In principle, the first supervisor should come from the host university at which the doctoral project is mainly carried out. Exceptions are regulated by the doctoral examining committee.

(3) The supervision agreement recognizes the thematic, financial and personal circumstances associated with the doctoral process. It regulates mutual rights and obligations that make the successful completion of the doctorate within the agreed timeframe seem realistic.

(4) The supervision agreement stipulates whether the dissertation is to be written in the form of a monograph or cumulative.

(5) In the case of a cumulative doctorate, the planned publications, their chronological order, authorship and the publication medium are regulated in the supervision agreement. If this is not fully possible at the time of the supervision agreement, responsibilities for decision-making, including the timetable, must be agreed upon.

(6) The supervision agreement only becomes effective upon acceptance as a doctoral candidate.

§ 8 Opening of the doctoral procedure

The opening of the doctoral procedure is regulated in § 8 of the RPO.

§ 9 Experts

The appointment and exclusion of reviewers is regulated in § 9 of the RPO.

§ 10 Examination board

The composition and working methods of the examination board are regulated in § 10 of the RPO.

§ 11 Dissertation

(1) Writing and assessment of the dissertation are regulated in § 11 of the RPO.

(2) The dissertation must generally be written in German or English. In special cases and at the request of the doctoral candidate, the doctoral examining committee may approve other languages if it is ensured that reviewers and examiners can be appointed in accordance with §§ 9 and 10 who are able to assess the thesis. In these cases, a summary in German or English must be attached.

(3) In the case of a cumulative doctorate and in addition to § 11 (4) RPO, at least two publications must have been published or accepted for publication in a peer-reviewed, internationally recognized publication organ. The doctoral candidate must be listed as the first author of at least one publication.

(4) The reviewer must provide written justification to the doctoral examining committee if the deadline for submission of the review is exceeded.

(5) The doctoral candidate will be informed of the reviews during the display with the opportunity to comment.

§ 12 Disputation

(1) The conduct and assessment of the disputation are regulated in § 12 of the RPO.

(2) The oral examination shall generally be held in German or English. At the request of the doctoral candidate, the doctoral examining committee shall decide, in consultation with the examination board, whether to conduct the oral defense in another language. It must be ensured that the members of the examination examining committee are proficient in the language in question.

§ 13 Overall grade of the doctorate

The determination of the overall grade of the doctorate is regulated in § 13 of the RPO.

§ 14 Completion of the doctorate and certificate

The completion of the doctorate is regulated in § 14 of the RPO.

§ 15 Publication of the dissertation

The publication of the dissertation is regulated in § 15 of the RPO.

§ 16 Withdrawal from the defense

Withdrawal from the defense is regulated in § 16 of the RPO.

§ 17 Deception and revocation of the doctorate

The procedure in the event of cheating and withdrawal of the doctorate is regulated in § 17 of the RPO.

§ 18 Inspection

Inspection is regulated in § 18 of the RPO.

§ 19 Appeal against decisions in the doctoral procedure

Appeals against decisions in the doctoral procedure are regulated in § 19 of the RPO.

§ 20 Protection periods

The protection periods are regulated in § 20 of the RPO.

§ 21 Compensation for disadvantages

Compensation for disadvantages is regulated in § 21 of the RPO.

§ 22 Retention of examination documents

The storage of examination documents is regulated in § 22 of the RPO.

§ 23 Doctorate in joint supervision with universities entitled to award doctorates and joint awarding of degrees

Doctorates in joint supervision with institutions entitled to award doctorates and joint degree conferral are regulated in § 23 of the RPO.

§ 24 Cooperative doctorates with universities not authorized to award doctorates

Cooperative doctorates with universities that are not authorized to award doctorates are regulated in § 24 of the RPO.

§ 25 Entry into force

Issued on the basis of the resolution of the Department council of 24.04.2023. The regulations come into force on the day after their publication in the Official Notices of the Graduate School for Applied Research in NRW.

Höxter, 12.05.2023

The Chairman of the Department council

signed *Maas*

(Prof. Dr. Klaus Maas)

Attachment

Doctoral program Cyber Physical Systems

Non-official version

Annex: Structured doctoral program Cyber Physical Systems of the Department of Technology and Systems of the Graduate School for Applied Research in North Rhine-Westphalia

The doctoral program relates to the overarching topic of Cyber Physical Systems, which is the scientific context for the doctoral candidates. The overall topic establishes a connection between the individual doctoral topics and is reflected in the disciplinary and interdisciplinary design of the program.

The doctoral program is technically oriented and is thematically based on two research areas. One research area addresses cyber-physical systems with inherent partial intelligence through embedded software, which collect data via sensors and influence the system and the environment through actuators, evaluate and store data, interact actively or reactively with the real physical and virtual digital world and are connected to each other and in global networks via digital communication devices. Particularly relevant topics in this research area are machine learning, networking and integration technology, communication technology, network architecture, embedded resource-constrained systems, internet technology and multimedia communication. The second research area covers the topics of sensor technology, image processing, automation, technical assistance systems, autonomous and self-organizing systems, control theory and signal processing and is summarized as *Instrumentation & Control*.

The doctoral program is aimed at graduates of computer science, electrical engineering, mechanical engineering, medical engineering or comparable courses of study. On the basis of successfully completing the doctoral program and passing the doctoral examination, the academic degree Dr.-Ing. is awarded if the subject matter is predominantly engineering, and the academic degree Dr. rer. nat. if the subject matter is predominantly natural sciences.

Program structure

Participation in this doctoral program is mandatory for doctoral candidates in the Department of Technology and Systems who are completing their doctorate at the NRW Graduate School.

The doctoral program consists of compulsory and optional modules and serves to structure and qualify the doctorate. In all doctoral phases, the overarching goal is to conduct one's own academic research by writing a dissertation. Participants in the doctoral program are thus enabled to help shape the digital transformation scientifically, whether in companies or at universities.

The doctoral program is designed for 3 years and includes a compulsory and a compulsory elective area. The modules are each recommended for a doctoral phase. Many modules are suitable as online events. Individual modules can also be acquired in doctoral programs of other departments of the PK NRW in consultation with the supervisory team, provided that the subject-specific fit is given. In addition, individual modules can also be attended and

credited by other organizers (universities, further education providers, etc.). The crediting of credits earned in courses outside of the fixed offer is based on the actual workload. The doctoral examining committee is responsible for determining subject-specific suitability and deciding on the extent to which the coursework can be credited.

Interdisciplinary qualification (compulsory area)

Compulsory courses for interdisciplinary qualification are the central offerings of the PK NRW:

- Seminar “Good Scientific Practice” (should be completed at the beginning of the doctoral procedure if possible)
- Seminar “Ethics and Responsibility in Science and Society”.

They are based on the recommendations of the DFG. Above all, they cover the basic principles of scientific work, working in teams, the handling of primary data and the rules for publications.

Scientific-disciplinary qualification (compulsory area)

In the scientific context of the Department of *Technology and Systems*, a compulsory lecture series *Cyber Physical Systems* takes place regularly. Participation in the lecture series is recommended for the first and intermediate doctoral phase. The lecture series includes guest lectures on research excellence as well as contributions on its transfer and on ethics and society. It has a broad thematic focus and covers the interaction between engineering and computer science, for example, the interaction with and adaptation to thematic fringe areas, the robustness of dynamic systems in unexpected situations, the anticipation of system behaviour based on empirical knowledge or the user-friendliness of applications.

Active participation in two doctoral colloquia in the first and middle doctoral phase is also mandatory. In these, doctoral candidates present the status of their doctoral project and place it in the context of cyber-physical systems. The focus is on the presentation of the research question, its definition and delimitation as well as the methodological approaches derived from it. In the second colloquium, the progress of the work is presented and discussed and the planned publications and participation in events are discussed. At least two supervisors of the presenting doctoral candidates should be present. In the two-day format, there is the opportunity for a variety of exchanges between the doctoral candidates in order to make use of and promote the direct exchange of experiences and feedback within their peer group.

In the first and middle doctoral phase, two subject-specific courses must be completed that offer in-depth insights into subject areas relevant to the doctoral topic. These courses are determined by the doctoral candidate together with the respective supervisory team. These include, for example, autonomous robotics, biomedical information technology, data science, digital systems, electrical engineering, embedded systems for mechatronics, human technology in sports and medicine, computer science, information technology, information technology, mechanical engineering, medical technology, smart health sciences or applied automation technology. A module examination in the sense of the degree programs is not a

prerequisite for recognition. Rather, the supervisory team decides on the form and extent of active participation in these subject-specific courses.

Another compulsory event is the presentation of your own research at an external scientific conference. This should take place in the middle or later phase of the doctoral program. In the case of a cumulative doctorate, this can take place in connection with a publication.

Compulsory elective area

Qualification measures are recommended in the areas of university didactics and interdisciplinary and transdisciplinary science. Further options exist with the optional courses recommended in the framework doctoral program. Three courses from this range must be taken.

Non-official version

Summary of the doctoral program

The following diagram illustrates the recommended course of the three-year doctoral program. Preparatory work, such as an initial literature search or the draft of the exposé, is not part of the doctoral program. Supporting offers and advice are partly provided by the graduate centers of the supporting universities. The same applies to any follow-up work, such as proof reading or translations. At some supporting universities, doctoral candidates can also apply for a final scholarship for the final phase of their doctorate.

Doctoral program <i>Cyber Physical Systems</i>			
	1st year		2nd year
			3rd year
Central compulsory events	Good scient. Practice	Ethics & responsibility (1 block)	
Compulsory events of the department	Lecture series		
	Doctoral candidate colloquium I	Doctoral candidate colloquium II	
	2 Specialist events		
		Presentation of own research at an external scientific conference	
Compulsory elective events from all departments	Workshop on university didactics (recommended)		
	Workshop inter- and transdisciplinary science (recommended)		
	Attendance at other events is recommended: Qualification courses as well as advanced courses offered by the Graduate School NRW and other providers; lecture series of other departments; further training stays in other working groups, also internationally; involvement in academic teaching, but the extent must not unduly impair the progress of your own research work; participation in further national and international research conferences with presentation of your own research results; participation in summer schools, winter schools or comparable events; special achievements in the transfer of your own research into practice.		

Fig. 1: Recommended course of the doctoral program