Report
of the Expert Panel
on the REACCREDITATION
of the University Postgraduate (Doctoral) Programme
Mathematics
Faculty of Science, University of Zagreb

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INTRODUCTION

The Expert Panel appointed by the Agency for Science and Higher Education (ASHE) created this Report on the Re-accreditation of the University Postgraduate (Doctoral) Programme Postgraduate University Programme in Mathematics on the basis of the Self-Evaluation Report of the Programme, other documentation submitted and a visit to the Faculty of Science, Department of Mathematics**.**

The Agency for Science and Higher Education (ASHE), a public body listed in EQAR (European Quality Assurance Register for Higher Education) and a full member of ENQA (European Association for Quality Assurance in Higher Education), re-accredits higher education institutions (hereinafter: HEIs) and their study programmes in line with the Act on Quality Assurance in Science and Higher Education (Official Gazette 45/09) and the Ordinance on the Content of a Licence and Conditions for Issuing a Licence for Performing Higher Education Activity, Carrying out a Study Programme and Re-Accreditation of Higher Education Institutions (OG 24/10). In this procedure parts of activities of higher education institutions and university postgraduate study programmes are re-accredited.
Expert Panel is appointed by the Agency's Accreditation Council, an independent expert body, to carry out independent evaluation of post-graduate university study programmes.

The Report contains the following elements:

- Short description of the study programme
- The recommendation of the Expert Panel to the Agency's Accreditation Council
- Recommendations for institutional improvement and measures to be implemented in the following period (and checked within a follow-up procedure)
- A brief analysis of the institutional advantages and disadvantages
- A list of good practices found at the institution
- Conclusions on compliance with the prescribed conditions of delivery of a study programme
- Conclusions on compliance with the criteria for quality assessment.

Members of the Expert Panel:

- Mark Davies, Professor, Faculty of Health Sciences and Wellbeing, Sunderland University, United Kingdom of Great Britain and Northern Ireland
- R. J. Pieters, Chair of Chemical Biology of Multivalent Systems, Utrecht University, Netherlands
- Mathias Senge, Chair of Organic Chemistry, Trinity College Dublin, Ireland
- Fabian Cerda, Max Planck Institute of Biochemistry, Germany
- Marianne Holmer, Professor, Head of Department of Biology, Syddansk Universitet, Denmark
- Isabel Sá Nogueira, Associate Professor, Head of Laboratory, Faculdade de Ciências e Tecnologia Universidade NOVA de Lisboa, Portugal
- Inger Elisabeth Måren, Associate Professor, Department of Biological Sciences, University of Bergen, Norway
- Peter Bennett, Reader in Biodiversity and Evolutionary Ecology, University of Kent, United Kingdom of Great Britain and Northern Ireland

- Domagoj Vugić, doctoral student, Institut Curie, France
- Maalte Braack, Director of Mathematical Seminar, Christian-Albrechts-Universität, Kiel, Germany
- Barbara Drinovec Drnovšek, Professor, Fakulteta za matematiko in fiziko, Univerza v Ljubljani, Slovenia
- Sebastian Eterovic, doctoral student, Mathematical Institute, University of Oxford, United Kingdom of Great Britain and Northern Ireland
- Donald Bruce Dingwell, Department for Earth and Environmental Sciences Chair of Mineralogy and Petrology, Ludwig-Maximilians-Universität München, Germany
- Giovanni B. Andreozzi, Coordinator of the Ph.D. programme in Earth Sciences, Sapienza Universita di Roma, Italia
- Ponfa Roy Bitrus, doctoral student, Department of Geology and Petroleum Geology, University of Aberdeen, United Kingdom of Great Britain and Northern Ireland
- Anders Omstedt, Professor Emeritus, Department of Marine Sciences, The Faculty of Science, University of Gothenburg, Sweden
- Rafael Laso Perez, doctoral student, Max Planck Institute for Marine Microbiology, Germany
- Kai-Olaf Hinrichsen, Professor, Technische Universitat Munchen, Germany
- Alexandra Pinto, Associate Professor, Director of PhD programme in Chemical and Biological Engineering, Universidade de Porto, Portugal
- Mohamed Hussien, doctoral student, Faculty of Chemistry and Pharmacy, L. M. Universitat Munchen, Germany
- Mikael Rinne, Associate Professor, Aalto University, Finland
- Anders Omstedt, Professor Emeritus, Department of Marine Sciences, The Faculty of Science, University of Gothenburg, Sweden.

The higher education institution was visited by the following Expert Panel members:

- Malte Braack, Universität, Kiel, Germany
- Barbara Drinovec Drnovšek, Univerza v Ljubljani, Slovenia
- Sebastian Eterović, University of Oxford, United Kingdom.

In the analysis of the documentation, site visit and writing of the report the Panel was supported by:

- Ivana Šimić, ASHE
- Marina Matešić, ASHE

During the visit to the Institution the Expert Panel held meetings with the representatives of the following groups:

- Management
- Study programme coordinators
- Doctoral candidates
- Teachers and supervisors
- Alumni.

The Expert Panel also had a tour of the library, IT rooms, student register desk and the classrooms.

SHORT DESCRIPTION OF THE STUDY PROGRAMME

Name of the study programme contained in the licence: Postgraduate University Programme in Mathematics
Institution delivering the programme: Faculty of Science, Department of Mathematics
Institution providing the programme: University of Zagreb, Josip Juraj Strossmayer University of Osijek, University of Rijeka, University of Split
Place of delivery: Faculty of Science, Department of Mathematics, Bijenička cesta 30, 10000 Zagreb
Scientific area and field: Natural Science, Mathematics

Number of doctoral candidates: 62

Number of HEI funded doctoral candidates (instructors at this or another HEI or institute): 41
Number of self-funded and those funded by employer: 21
Number of inactive doctoral candidates (still entitled to graduate): 11

Number of supervisors: 68
Number of teachers: 91

Ratio of officially appointed supervisors and their doctoral candidates: 1:1
Ratio of potential supervisors to total No. of doctoral students: 68 : 62 (1:1.1)

Taught / research ratio: 20 : 80 (%)

Basic course	6 ECTS credits
Advanced course 60 hours	8 ECTS credits
Advanced course 30 hours	4 ECTS credits
Introduction to research	24 ECTS credits
Seminar	20 ECTS credits
Scientific colloquium	4 ECTS credits
Research activity	20 ECTS credits
Doctoral thesis	28 ECTS credits

Learning outcomes of the study programme:
1. Knowledge
1.1. (LO1) To analyse critically and to relate the current theoretical knowledge in mathematics

2. Comprehension skills
2.1. (LO2) To identify the relevant research topics in the specific areas of mathematics and to set a hypothesis in the context of research of a specific problem
2.2. (LO3) To develop a mathematical model in the applications in science and engineering, using advanced mathematical theories and methods (algorithms)
2.3. (LO4) To design a method of resolving a selected problem, aimed to obtain the original results and new theoretical knowledge

3. Psychomotor skills

3.1. (LO5) Development of algorithm solutions and software implementations for problem solution from computer aided applications

4. Social skills
4.1. (LO6) To communicate the research results on various levels (published scientific papers, scientific conferences, wider scientific community and general public)

5. Independence
5.1. (LO7) To plan, propose and independently lead a research project
5.2. (LO8) To apply the knowledge independently in interdisciplinary professional (industrial) projects
5.3. (LO9) To recognize new important areas of application and to propose new directions in research and new teaching curricula

6. Responsibility
6.1 (LO10) To actively promote the role of mathematics in the technological progress and development of the knowledge based society.
6.2. (LO11) To actively participate in the education of new generations and the transfer of knowledge on all programme levels, including independent doctoral candidates' supervision

RECOMMENDATION BY THE EXPERT PANEL TO THE ASHE'S ACCREDITATION COUNCIL

Upon the completion of the re-accreditation procedure and the examination of the materials submitted (Self-Evaluation Report etc.), the visit to the higher education institution and interviews with HEI members in accordance with the visit protocol, the Expert Panel renders its opinion in which it recommends to the Accreditation Council of the Agency the following:

issue a confirmation on compliance for all performing parts of activities (renew the licence).

SHORT SUMMARY

This PhD programme is a joint programme of the Universities of Zagreb, Split, Osijek and Rijeka, although formally, the Faculty of Science of the University of Zagreb is the only carrier. That is why the students have usually their origin in these four universities. The individual mathematical knowledge of the PhD candidates is therefore heterogeneous with respect to their thematic orientation and quality. That is why this PhD programme contains two important qualifiers (Basic Courses) to be passed after the first year. Further courses are offered to provide deep and broad mathematical knowledge to the students and to help to accomplish the PhD thesis. On the basis of the SER and the meetings, the Expert Panel is convinced that this programme features - in the most aspects - a high level of quality. This is finally confirmed through the output of high quality journal publications authored by current and former PhD students and their supervisors out of this programme. In some points we see room of improvement, this is mainly in the aspect of international visibility of the programme. The reason is mostly that the recruited PhD students are nearly exclusively Croatian students. The entire study programme has definitely the potential to be labelled in the near future to be of high quality.

RECOMMENDATIONS FOR THE IMPROVEMENT OF THE STUDY PROGRAM

1. More effort for the recruitment of talented *international* students should be made.
2. The programme administration should monitor statistics on several aspects (e.g. study length, gender balance, completion rates, cancelled / not-accomplished studies).
3. More information to the students should be provided explaining the possibility to attend Reading Courses as Advanced Courses. It should be checked whether the module 'Introduction to Research' can be erased in the curriculum since it does not represent a course or seminar, but it is rather a placeholder for own research.

ADVANTAGES OF THE STUDY PROGRAM

1. High level of quality with respect to mathematical contents and thesis outcome.
2. Joint programme of four Croatian Universities (Zagreb, Split, Osijek, and Rijeka).
3. Variety of available advanced courses.
4. Relative large quota of fully or partially funded students; reduced or waived tuition fee for the majority of students.

DISADVANTAGES OF THE STUDY PROGRAM

1. International visibility of the study programme can be enhanced.

2. Lack of teaching and supervisor training; transparency of teaching and supervisor evaluation is not given.
3. Restricted online access to accomplished PhD thesis.
4. Study programme is mainly theoretically oriented, which is good for formation of future academic personal. However, management skills or organizing skills are rarely trained.

EXAMPLES OF GOOD PRACTICE

1. Cooperative PhD programme on national level.
2. Variety of available Advanced Courses.
3. Way of financing the studies of the students.

COMPLIANCE WITH THE PRESCRIBED CONDITIONS FOR THE DELIVERY OF A STUDY PROGRAMME

Minimal legal conditions:	**YES/NO notes**
1. Higher education institution (HEI) is listed in the Register of Scientific Organisations in the scientific area of the programme, and has a positive reaccreditation decision on performing higher education activities and scientific activity.	YES
2. HEI delivers programmes in the two cycles leading to the doctoral programme, i.e., first two cycles in the same area and field/fields (for interdisciplinary programmes), and employs a sufficient number of teachers as defined by Article 6 of the Ordinance on the Content of a Licence and Conditions for Issuing a Licence for Performing Higher Education Activity, Carrying out a Study Programme and Re-Accreditation of Higher Education Institutions (OG 24/10).	YES
3. HEI employs a sufficient number of researchers, as defined by Article 7 of the Ordinance on Conditions for Issuing Licence for Scientific Activity, Conditions for Re-Accreditation of Scientific Organisations and Content of Licence (OG 83/2010).	YES
4. At least 50% of teaching as expressed in norm-hours is delivered by teachers employed at the HEI (full-time, elected into scientific-teaching titles).	YES
5. Student: teacher ratio at the HEI is below 30:1.	YES
6. HEI ensures that doctoral theses are public.	YES with limitations*
*The theses are uploaded on HEI online repository (http://digre.pmf.unizg.hr/) but electronic access is unfortunately **restricted for some thesis**: 48 theses are uploaded, out of which 13 are restricted to staff with password. The repository of the National and University Library DABAR at the website https://dr.nsk.hr/en contains only two mathematical dissertations.	
7. HEI launches the procedure of revoking the academic title if it is determined that it has been attained contrary to the conditions stipulated for its attainment, by severe violation of the studying rules or based on a doctoral thesis (dissertation) that has proved to be a plagiarism or a forgery according to provisions of the statute or other enactments.	YES
Additional/ recommended conditions of the ASHE Accreditation Council for passing a positive opinion	**YES/NO (notes)**
1. HEI (or HEIs in joint programmes) has at least five teachers appointed to scientific-teaching titles in the field, or fields relevant for the programme involved in its delivery.	YES

2. In the most recent reaccreditation, HEI had the standard Scientific and Professional Activity marked as at least "partly implemented" (3).	YES
3. The doctoral programme is aligned with the HEI's research strategy.	YES
4. The candidate : supervisor ratio at the HEI is not above 3:1.	YES 68:62 (1,1)
5. All supervisors meet the following conditions: a) PhD, elected into a scientific title, holds a scientific or a scientific-teaching position and/or has at least two years of postdoctoral research experience; b) active researcher in the scientific area of the programme, as evidenced by publications, participation in scientific conferences and/or projects in the past five years (table 2, Supervisors and candidates); c) confirms feasibility of the draft research plan upon admission of the candidate (or submission of the proposal); d) ensures the conditions (and funding) necessary to implement the candidate's research (in line with the draft research plan) as a research project leader, co-leader, participant, collaborator or in other ways; e) trained for the role before assuming it (through workshops, co-supervisions etc.); f) received a positive opinion of the HEI on previous supervisory work.	a) YES b) YES c) YES d) YES e) NO* f) YES
Rationale: Supervision training is not organized in a systematic way. But teachers at HEI holding the title of Assistant Professor or higher have experience in leading Diploma/MSc final papers.	
7. All teachers meet the following conditions: a) holds a scientific or a scientific-teaching position; b) active researcher, recognized in the field relevant for the course (table 1, Teachers).	 YES YES
8. The supervisor normally does not participate in the assessment committees.	NO*
* There are three committees during the PhD. In the first and second committee (proposal assessment, final thesis assessment) the supervisor is not a member. In the third committee (thesis defence) the supervisor participates but never as a chair.	
8. The programme ensures that all candidates spend at least three years doing independent research (while studying, individually, within or outside courses), which includes writing the thesis, publishing, participating in international conferences, field work, attending courses relevant for research etc.	YES

QUALITY ASSESSMENT

1. RESOURCES: TEACHERS, SUPERVISORS, RESEARCH CAPACITIES AND INFRASTRUCTURE	
1.1. HEI is distinguished by its scientific/ artistic achievements in the discipline in which the doctoral study programme is delivered.	**High level of quality** The Faculty of Science Department of Mathematics participates in the *Scientific Centre of Excellence for Quant and Complex Systems and Lie Algebra Representation*. They are members of 20 research projects, including Marie Curie Actions - International Outgoing Fellowship. They also took part in some applied projects with the industry in Croatia. The Mathematics Department employees have strong international connections through numerous bilateral and multilateral grants. They publish regularly in international research journals.
1.2. The number and workload of teachers involved in the study programme ensure quality doctoral education.	**High level of quality** The major part of the lectures is delivered by their own faculty. Teachers other than those of the Faculty of Science Department of Mathematics are mostly from the university partners in the joint study programme (Osijek, Rijeka, and Split). The teaching workload in terms of norm hours (NH) is within the acceptable range, i.e. NH<300.
1.3. The teachers are highly qualified researchers who actively engage with the topics they teach, providing a quality doctoral programme.	**High level of quality** The number of publications and citations in prestigious international journals is high. The Department provides an internal quality control for PhD supervision which is mainly based on research output.
1.4. The number of supervisors and their qualifications provide for quality in producing the doctoral thesis.	**High level of quality** The ratio of supervisors-students is almost 1:1 and can be considered to be very good. The scientific output of potential supervisors is checked by an internal quality control mechanism (see §1.5 below). Our quality checks also confirm the high scientific productivity of the supervisors.

1.5. The HEI has developed methods of assessing the qualifications and competencies of teachers and supervisors.	**High level of quality** There are methods for evaluating teachers and supervisors prescribed by both the Faculty of Science and the Mathematics Department. In the latter, the scientific assessment is based partly on letters from internationally recognized experts from leading world universities, whereas the teaching assessment is based partly on student polls. The Panel encourages more transparency of the committees evaluating teachers and supervisors.
1.6. The HEI has access to high-quality resources for research, as required by the programme discipline.	**High level of quality** Candidates have access to appropriate computer pools and multiprocessor/multicore computers are available for students working in areas requiring strong computing power. There are also study rooms, and shared offices are available for those students who are teaching assistants, which is most of them. There is a library equipped with current issues of many significant journals and there are effective methods for the students to obtain books and journals not yet present in the library. Lectures are recorded with a high level of quality and the recordings are made available for the students. Students from other universities in Croatia can attend the lectures online in real time and ask questions in a somewhat direct manner. The Department is looking for ways to further improve this system of remote lectures.
2. INTERNAL QUALITY ASSURANCE OF THE PROGRAMME	
2.1. The HEI has established and accepted effective procedures for proposing, approving and delivering doctoral education. The procedures include identification of scientific/ artistic, cultural, social and economic needs.	**High level of quality** This doctoral programme has a long tradition and decades of experience. It is the only mathematical PhD programme in Croatia and includes contributions from three other Croatian Universities (Rijeka, Split, and Osijek). The study and research programme are versatile and clearly include scientific and economic needs.

2.2. The programme is aligned with the HEI research mission and vision, i.e. research strategy.	**High level of quality** The PhD programme is in line with the research mission and vision of the HEI. In particular, the programme creates excellent and internationally recognized researchers, produces valuable academic staff for many departments in different institutes (Mathematics, Electrical Engineering, Mechanical Engineering etc.). The majority of the supervisors of this programme have experience with international research projects. An impressive number of high quality journal papers are produced by (former) PhD students and their supervisors.
2.3. The HEI systematically monitors the success of the programmes through periodic reviews, and implements improvements.	**High level of quality** The programme undergoes regular changes on the basis of reviews and feedbacks of students and alumni. In particular: (a) the number of mandatory courses have been reduces to give more space and time for own research, (b) a joint annual seminar of several departments of the entire faculty was introduced in order to strengthen the connections between the institutes and give opportunity to young researchers to present their work on a wider (not specialized) auditorium. Several minor changes of the programme have led to further improvements.
2.4. HEI continuously monitors supervisors' performance and has mechanisms for evaluating supervisors, and, if necessary, changing them and mediating between the supervisors and the candidates.	**Improvements are necessary** The PhD programme measures the quality of supervision by considering the publication record of supervisors and their PhD students. This is certainly not a complete assessment, but it is reasonable. However, the completion rates are not monitored at all. This should be done in order to obtain a more complete picture of supervision quality. The programme does not provide a formalized mediation in the case of conflicts, but anyway, students are allowed to change the supervisor. However, the Panel did not encounter indications of poor candidate-supervisor relation in the past.

2.5. HEI assures academic integrity and freedom.	**Improvements are necessary** The programme coordinators should check the possibility to use software for plagiarism checks. The access of accomplished PhD thesis is possible by access to the library and, partially, online. The online access is not really possible for the public (restricted access, involved enquiries with uncertain and time consuming success).
2.6. The process of developing and defending the thesis proposal is transparent and objective, and includes a public presentation.	**High level of quality** The HEI has developed a clearly defined process for PhD-proposal submission. The submission includes candidates CV's, a proposal description and evidence of the supervisors competences. Head of the Study Programme, in consultation with the Council of the Doctoral Study Programme, appoints the committee for the evaluation and defence of thesis proposal. In summary, the Panel encountered sufficient control about thesis proposals with significant quality control.
2.7. Thesis assessment results from a scientifically sound assessment of an independent committee.	**High level of quality** The HEI has developed a procedure to appoint objective and independent committees for the thesis assessment. Foreign (international) committee members are provided in the case that the thesis is written in English language. As a matter of fact, journal publication in Mathematics may take many months up to years. Hence, a strict rule of at least one journal publication prior to thesis defence would be a too severe obstruction for the candidates. However, the majority of theses deliver such publications. Further publications after thesis completion are usually the case.
2.8. The HEI publishes all necessary information on the study programme, admissions, delivery and conditions for progression and completion, in accessible outlets and media.	**Improvements are necessary** Croatian-speaking students will find all necessary information on the web and on-site at the Department. However, we see room for improvement for the orientation of international students who do not speak the Croatian language. The most relevant, but also less relevant information should be made easily accessible via the web site in the English language. Moreover, international advertising of the study

	programme may lead to a wider visibility of the programme. This may increase the availability of highly talented PhD candidates even further.
2.9. Funds collected for the needs of doctoral education are distributed transparently and in a way that ensures sustainability and further development of doctoral education (ensures that candidates' research is carried out and supported, so that doctoral education can be completed successfully).	**High level of quality** It is important to keep in mind that most of the students' pay a reduced (or even waived) tuition fee. The remaining incoming fees are used for direct costs of the programme (e.g., tele-conferences of joint lectures with partner Universities, workshop attendance, etc.). After completion of thesis, parts of the tuition fee are used for the support of follow-up PhD students to attend workshops etc.
2.10. Tuition fees are determined on the basis of transparent criteria (and real costs of studying).	**High level of quality** As already mentioned in the previous §2.9, the tuition fee are used for necessary direct costs of the study programme. The overall costs are considered to be moderate.
3. SUPPORT TO DOCTORAL CANDIDATES AND THEIR PROGRESSION	
3.1. The HEI establishes admission quotas with respect to its teaching and supervision capacities.	**High level of quality** The Department has enough teaching and supervisors capacities for all the candidates admitted. Given the number of applicants to the programme, almost all applicants satisfying the mandatory requirements are admitted, so prescribed quotas are not necessary so far. There is a large group of potential supervisors working in many areas of mathematics. Supervisors mostly take on only one student at a time, in special cases two. Supervisors are assigned by taking into account the students' interests. In necessary circumstances, the supervisor can be changed during the course of the programme. Students said that they felt that supervisors were accessible and met with them on a regular basis as needed. Teaching workload for supervisors is within the norm. The obligations of supervisors and of candidates are explicitly stated in the Ordinance on Doctoral Study Program of the University and in the Ordinance on Doctoral Study at the Faculty of Science.

3.2. The HEI establishes admission quotas on the basis of scientific/ artistic, cultural, social, economic and other needs.	**Improvements are necessary** As explained in §3.1, there are no admission quotas. Most successful candidates are employed, mainly in academia and, to a lesser extent, industry. Alumni expressed great satisfaction with the knowledge obtained during the programme. There is sporadic collaboration with other academic faculties and sometimes with the private sector, giving candidates the opportunity of doing more applied work during their research, or being employed by these institutions after they complete the programme. Some candidates expressed interest in being able to be part of projects in cooperation with industry and economy. It is recommended that the Mathematical Department look into ways of increasing such type of collaborations. It is recommended that the Mathematics Department keep statistics on their recently graduated alumni.
3.3. The HEI establishes the admission quotas taking into account the funding available to the candidates, that is, on the basis of the absorption potentials of research projects or other sources of funding.	**High level of quality** As explained in §3.1, there are no admission quotas. Most students are fully funded by being either employed as teaching assistants or in research projects. In both cases, the employment is beneficial for future career. Self-funded students only need to pay half of the tuition fee. Tuition fees are paid only for three years.
3.4. The HEI should pay attention to the number of candidates admitted as to provide each with an advisor (a potential supervisor). From the point of admission to the end of doctoral education, efforts are invested so that each candidate has a sustainable research plan and is able to complete doctoral research successfully.	**High level of quality** At admission or shortly after, candidates are assigned a supervisor-advisor. This assignment is made considering the research interests of the student and whether or not the student has been recruited by a faculty member. The supervisor-advisor is responsible for monitoring the progress of the candidate and he/she writes periodical reports about the candidate. During the first year of the programme, candidates have to take two basic courses. Experience showed that candidates come with very different mathematical backgrounds, and so these courses are implemented to level the candidates' knowledge. The courses are specially designed for the doctoral programme. Advanced

	courses are also part of the programme, and they change from year to year considering the interests of current candidates. Advanced courses offer knowledge in current developments in different areas of mathematics. In the first-year, the Head of the Program advises students on strategies for taking the qualifying examinations, the selection of the research topic and the selection of advanced courses. After the qualifying exams are approved, a supervisor is assigned to the candidate. It is required that the supervisor have recent publications in the areas of interest of the student. In most cases, the supervisor-advisor becomes the supervisor of the candidate. The supervisor is responsible for overseeing the progress of the doctoral thesis. A committee, which does not include the supervisor, examines the proposed thesis project to ensure that it is realistic and that it will be of significant scientific value. One of the members of the Panel that evaluates the thesis defence has to be external.
3.5. The HEI ensures that interested, talented and highly motivated candidates are recruited internationally.	**Improvements are necessary** The programme's website is available in English, but no real efforts are made to advertise the programme to international applicants. Many professors of the Mathematical Department have been abroad and have connections with other universities around the world, so advertising the programme should not be difficult. The professors and the students have a high level of English, and so the courses and exams could easily all be in English. The number of doctoral theses written in English has steadily increased over the last few years. The professors themselves manifested interest in attracting with international students, as this would enhance the application pool which, as explained in §3.1, is small enough that almost all applicants satisfying the mandatory requirements are admitted. The main barrier for attracting international students is the current lack of funding available for this purpose. As undergraduate classes are taught in Croatian, it is unlikely that international students could be employed as teaching

	assistants. However, the Mathematical Department should consider making strong efforts to obtain available funding from the Faculty of Science, the government, or the EU to be able to achieve this important goal.
3.6. The selection process is public and based on choosing the best applicants.	**High level of quality** As explained in §3.1, almost all candidates satisfying the mandatory requirements are admitted. These requirements consider past performance in the form of grades, proficiency in a world language enabling the applicant to read mathematical references in that language, and the necessity of a Master degree in Mathematics, Mathematics and Informatics, Mathematics and Physics or equivalent.
3.7. The HEI ensures that the selection procedure is transparent and in line with published criteria, and that there is a transparent complaints procedure.	**Improvements are necessary** The selection procedure is transparent and almost every applicant satisfying the admission criteria is admitted. The selection procedure documents are available on demand. The Department should determine formal procedures for possible complaints coming from students and applicants.
3.8. There is a possibility to recognize applicants' and candidates' prior learning.	**High level of quality** Candidates who have prior learning may request to take the qualifying exams earlier than usual and, if approved, they can use more time in the first year for their research. The requests are handled by the Head of the PhD Study Programme in coordination with the supervisor-advisor. Recognition of ECTS credits based on previous achievements made through other study programs is examined case by case by the management of the Doctoral Study Programme to decide whether the situation merits validation.
3.9. Candidates' rights and obligations are defined in relevant HEI regulations and a contract on studying that provides for a high level of supervisory and institutional support to the candidates.	**High level of quality** The Ordinance on Doctoral Study Programme of the University and the Ordinance on Doctoral Study Programme at the Faculty of Science incorporate chapters laying out the duties of supervisors and the rights and obligations of candidates.

3.10. There are institutional support mechanisms for candidates' successful progression.	**High level of quality** Candidates are usually employed as teaching assistants or by a research project. This ensures that the students have funding to attend conferences and scientific workshops where they get a chance to present their work. There is a committee in charge of evaluating the thesis proposal of the candidates to ensure that they are realistic and scientifically significant. This has resulted in a significant number of candidates with publications or accepted papers around the time they complete the programme. The Department may wish to keep overall statistics of the success of the candidates with regard to presence in international conferences, funding received from non-academic institutions, and publications. It is also suggested that they keep track of the amount of teaching that the candidates are doing as it can vary greatly between candidates.
4. PROGRAMME AND OUTCOMES	
4.1. The content and quality of the doctoral programme are aligned with internationally recognized standards.	**High level of quality** The PhD study programs in Mathematics within Europe are diverse. The choice to demand two qualifying exams in the first year and to offer Advanced Courses in the second two years is justified due to the contributions from 4 universities. The procedures are as expected for a high-quality PhD programme. Although there is no legal obstacle to admit interdisciplinary PhD projects, the number of such projects is extremely low. The programme may benefit from an enhancement of interdisciplinary projects (and Advanced Courses) with mathematical contents as a core discipline.
4.2. Programme learning outcomes, as well as the learning outcomes of modules and subject units, are aligned with the level 8.2 of the CroQF. They clearly describe the competencies the candidates will develop during the doctoral programme, including the ethical requirements of doing research.	**High level of quality** The Basic Courses are designed for PhD level. They give an improved basis for the subsequent research area of the thesis. This knowledge is accomplished by the content of Advanced Courses of contemporary mathematics. In several compulsory seminars the students obtain experience in presentation techniques and

	scientific exchange of mathematical contents. Finally, the students learn to write research papers through working with original literature and compiling their own scientific results.
4.3. Programme learning outcomes are logically and clearly connected with teaching contents, as well as the contents included in supervision and research.	**High level of quality** With the Qualifying (Basic) Courses the students obtain the necessary background to follow the Advanced Courses and for the quality of their research. Advanced Courses treat up-to-date topics closer to their research areas and present recent scientific developments. Through seminars and colloquia, the students develop the ability to communicate their research results to the scientific community.
4.4. The doctoral programme ensures the achievement of learning outcomes and competencies aligned with the level 8.2 of the CroQF.	**High level of quality** The quality of the thesis is high according to the accepted standards. This is proved by numerous publications in international research journals resulting from them. The site visit gave insight to a sample of thesis.
4.5. Teaching methods (and ECTS, if applicable) are appropriate for level 8.2 of the CroQF and assure achievement of clearly defined learning outcomes.	**High level of quality** Basic Courses and Advanced Courses are given in class. Nowadays, all of them are recorded and HEI enables the students to follow the course also outside University of Zagreb and also at some other opportunity. Seminars allow, and demand from the students, to present their achievements to the community of interested students and researchers. The curriculum comprises in the first year 'Introduction to Research' with 24 ECTS. However, this is not a formalized course but rather a place holder for orientation and doing own research. It should be checked whether this component can just be erased and hence leaving room for own research. In order to improve the programme even further the Department should make clear to the candidates that they can request Reading Courses in exchange for Advanced Courses.

4.6. The programme enables acquisition of general (transferable) skills.	**Improvements are necessary** The most important skills for working in academia are provided within this PhD study programme. Students are well prepared to do research, to present their research to their colleagues orally or in writing. Writing skills are also trained sufficiently. However, apart from this, management skills or organizing skills are rarely trained. The programme may benefit by implementing actions (e.g. offer optional courses, integrate students to workshop organization etc.) to train such skills as well. Support from the faculty would be beneficial.
4.7. Teaching content is adapted to the needs of current and future research and candidates' training (individual course plans, generic skills etc.).	**High level of quality** Different advanced courses are given each year which exposes the students to the most recent scientific results relevant to their research areas. However, students do not seem to be sufficiently informed about the possibility of attending "Reading Courses" in the case that Advanced Courses are not close enough to their research area. Taking this opportunity would improve the programme even further.
4.8. The programme ensures quality through international connections and teacher and candidate mobility.	**Improvements are necessary** Members of the HEI (Mathematical Department) have good international connections. Doctoral students have the possibility to attend conferences and summer schools abroad. However, we see room for improvement with respect to internationalization:) HEI should do more to attract excellent international students from outside Croatia. Attracting good PhD students can be also done on personal basis.) HEI should also make more effort to attract distinguished international faculty staff for short and long term positions.) They should continue to encourage their employees and their doctoral students to attend summer schools and conferences abroad.

*** NOTE: RECOMMENDATIONS OF THE EXPERT PANEL TO THE ASHE'S ACCREDITATION COUNCIL AND QUALITY LABEL**

The role of the Expert Panel in the re-accreditation of doctoral study programmes is manifold. The Expert Panel or part of the Expert Panel visiting a higher education institution drafts a report on the basis of a self-evaluation report, the accompanying relevant documentation, and a site visit to HEI. The draft report is adopted by all members of the Cluster Expert Panel, while the president of the Cluster Expert Panel is responsible for coordinating the assessment levels.

The report contains an assessment on whether a doctoral study programme delivered at a higher education institution complies with the prescribed laws and by-laws, as well as any additional/recommended requirements defined by the Agency's Accreditation Council, and whether a higher education institution can obtain a positive, i.e. satisfactory quality assessment according to the criteria set out in this document. Moreover, the Expert Panel must make recommendations for quality improvement.
Based on the assessment of all these elements, the Expert Panel may propose to the Accreditation Council of the Agency to issue either a confirmation on compliance, a letter of expectation for the period up to three (3) years in which period the higher education institution should eliminate the identified deficiencies, or to deny the license.

If the Expert Panel has assessed that a doctoral study programme delivered by a higher education institution does not meet legal and other requirements or that the quality of a study programme is not ensured (i.e. that HEI does not meet additional requirements or recommendations made by the Accreditation Council, or has a very poor quality assessment), they should propose to the Accreditation Council to deny the license.

If the Expert Panel considers that the relevant laws and bylaws have been met by a higher education institution, but that certain elements mentioned above do not meet the quality requirements, while they consider that the identified shortcomings can be corrected within a time frame of three years, they should issue a letter of expectation.

If the Expert Panel considers that all legal and additional/recommended requirements have been met and the quality assessment is satisfactory, i.e. that a study programme fulfils the learning outcomes appropriately defined for that level and scientific area, they may propose the issuance of a certificate and have a HEI commit to quality improvement and reporting to the Agency during the follow-up period.

Finally, if the Expert Panel has, in accordance with the criteria mentioned above, proposed issuing the certificate of compliance and assessed that, in addition to meeting the minimum quality requirements – i.e. the qualification framework level - for a study programme, the programme should be identified as a doctoral programme of a 'high level of quality', the Expert Panel may propose to the Agency's Accreditation Council that such a doctoral study programme be awarded the 'high quality label'. Thus the Agency, with the consent of the Accreditation Council, grants a higher education institution the right to use the label for their academic and promotional purposes.

The 'high quality label' cannot be proposed or awarded to a programme or a higher education institution that does not comply with the requirements laid down by the laws and bylaws mentioned in this document, and any additional requirements recommended by the Accreditation Council. Moreover, the quality assessment awarded to a study programme should reflect a high level of quality inasmuch that at least half of the sub-criteria in each of the quality assessment criteria are assessed as being of high quality. The Accreditation Council of the Agency issues a final opinion on the label awarded. The content and form of the quality labels shall be prescribed by the Agency in a relevant general act.

The Accreditation Council of the Agency discusses the final report with all recommendations and suggestions, and issues their opinion on the report. Based on a prior opinion of the Accreditation Council, the Agency issues an Accreditation Recommendation to the minister responsible for science and higher education, and upon receipt of the minister's final decision on the outcome of the procedure, awards the 'high quality label" to a higher education institution.