EVALUATION OF THE EDUCATION AND DEGREE PROGRAMMES OF THE UNIVERSITY OF HELSINKI 2001-02

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Self-evaluation report of the Departments of Mathematics, Physical Sciences, Chemistry and Computer Science

Helsinki, November 2001

CONTENT

OVERVIEW

This report deals with the degree programmes in the exact natural sciences, which in this case include Mathematics, Physical Sciences, Chemistry, and Computer Science. These are disciplines in which concepts and knowledge are organised deductively (usually on the basis of empirical material) into a systematic hierarchical structure. The disciplines also aim at mathematical modelling and creative, yet methodical, problem solving. Studies in the disciplines involve a great number of practical skills, which are developed through laboratory work, problem-solving and computer courses carried out in small groups. These methods considerably increase the cost of education.

Basic education aims at the MSc degree, which is the de facto basic degree in Finland and consists of a minimum of 160 credits. Two minor subjects, which together account for a minimum of 45 credits, are an essential part of the degree. After many years of absence, the lower 120-credit academic degree, corresponding to the Bachelor's degree in many countries, was reintroduced into the degree structure in the late 1990s in accordance with international degree structures. However, Finnish qualification requirements (for example, those of subject teachers) often do not recognise the lower degree, and students of exact (natural) sciences rarely complete it. About half of the lower degree consists of the major subject, leaving a considerable share for minor subjects and "other studies". Owing to the hierarchical knowledge structure of the disciplines, this degree may not offer enough depth of studies or sufficient professional skills. Postgraduate studies mainly aim at a Doctoral degree within 4-5 years of the Master's degree. It is also possible to complete a lower Licentiate degree after approximately two years of postgraduate studies.

The common problem of exact (natural) sciences is their weak position in the Finnish school system, which leads to there being too few talented and motivated students. As a result, a large number of students drop out after the first year of studies. Some of the main reasons for interrupted studies include students using their study right to prepare for entrance exams in other faculties or universities, as well as the fact that some students obtain two study rights and later drop one of them. Particularly in Computer Science, the heavy recruiting of businesses has also led to students leaving their studies. To improve the situation, the departments have worked to enhance tutoring, increase instruction that improves study skills, organise alternative teaching in the Open University, and change the selection method so as to emphasise motivation and the role of the major subject. These measures have led to a slight improvement. The regulation allowing first-year students to accept only one study right has also had a favourable influence. In the case of students that started their studies in 2000, the situation looks more promising. The number of students continuing with second-year studies has now increased considerably.

The Faculty of Science conducts ongoing development work concerning teaching and the degree programmes. The report "Development of Teaching at the Faculty of Science 1998-2000" is appended to this self-evaluation report.

In 1996-2000, the Ministry of Education granted an additional appropriation to the departments as part of the national LUMA development programme for the development and extension of teaching, particularly that related to teacher training.

SELF-EVALUATION REPORT OF MATHEMATICS

This self-evaluation report was drafted by a working group appointed by the Department and consisting of Hannu Honkasalo, Professor; Tapani Hyttinen, Academy Research Fellow; Saara Lehto, student; Jussi P. Nieminen, student; Kalevi Suominen, Professor; Hans-Olav Tylli (Chairman), Academy Research Fellow.

1. Overview

The educational goals of the Department of Mathematics include providing basic and postgraduate education in Mathematics to enable graduates to work in a variety of expert and educational tasks requiring mathematical skills in different sectors of society. Other goals include the provision of systematic education and supervision to those aiming at a career in research. The Ministry of Education and society in general have continued to emphasise the importance of mathematical skills and education to the IT sector and school instruction, among others.

An annual average of 46 MSc degrees, 5 Licentiate degrees and 3 Doctoral degrees were completed in 1996-2000. The number of MSc degrees, in particular, has considerably increased since the early 1990s. The Department's long-term goal is to raise the number of MSc degrees to an annual 65–70 (provided that enough financial resources are available). The Department also wishes to increase the number of postgraduate students. The Department of Mathematics offers one of the most extensive programmes of instruction measured in completed credits at the University of Helsinki (Table 1 on p. 10).

The development of instruction focuses on *teacher training* (the Department aims to meet the increased demand for teachers), *financial and insurance mathematics*, and *computer-aided mathematics*, for which a new 5-year professorship was recently established. In 1997-2000, the Department of Mathematics was able to increase the amount of instruction and make it more efficient thanks to the so-called LUMA funding. The instalment of FIM 1.7 million, which was not received in 2001, has proved to be difficult to compensate for. The Department's degree paths were renewed in 1999.

One of the central goals is to support the teaching provided in the Department's internationally successful fields of research. As of 2002, the Department will house a centre of excellence for analysis and mathematical physics. Supporting the instruction provided by the centre will demand considerable investments from the Department starting with basic education.

The departmental library has a selection of mathematical research journals of international top quality, which other Finnish departments of mathematics turn to when needed. While the library's book collection is more of a research nature, its textbook selection has also grown considerably in the past years.

2. Content of education and degree programmes

The major subject studies in the MSc degree of Mathematics consist of intermediate and advanced studies. The intermediate studies are largely the same for all major students of Mathematics; common courses include *Differential and integral calculus I* (parts I.1 and I.2), *Linear algebra I* and *Differential and integral calculus II*. These and other intermediate courses aim to enhance the students' skills in core mathematics needed at the later stages of studies.

At the advanced stage, the degree programme in Mathematics is divided into four sub-programmes, two of which are further divided into four specialisation areas each. This division was implemented in autumn 1999, with the intention to provide as wide a coverage as possible of all the typical career

choices available for mathematicians. The sub-programmes and specialisation areas include the following:

- General Mathematics sub-programme
  - Algebra and topology path
  - Analysis path
  - Mathematical physics path
  - Mathematical logic path
- Applied Mathematics sub-programme
  - Applied mathematics path
  - Stochastic modelling and data analysis path (together with the Rolf Nevanlinna Institute)
  - Computer-aided mathematics path
  - Financial and insurance mathematics path
- Computer Mathematician sub-programme (jointly with the Department of Computer Science)
- Teacher of Mathematics sub-programme

The sub-programmes and specialisation areas are not fully separated from each another even at the advanced stage (this would be impossible to implement due to resource availability, in addition to which, the different paths still require much of the same skills in core mathematics). It is rather a question of how the different subfields of mathematics are emphasised. The number of sub-programmes and the related course offering at the Department of Mathematics is the most versatile of all Finnish universities. The sub-programme for teachers produces a significant share of the Department's MSc degrees (some 52% in 1996-2000). The number of graduates in other options and paths has also increased. The Department of Mathematics at the University of Helsinki differs from other Finnish universities in also educating a considerable number of mathematicians other than teachers. This requires more resources, as the studies in mathematics of teachers consist of 75 credits, whereas the requirements in other paths is usually 93 credits. In addition, the Rolf Nevanlinna Institute has supervised some theses, and licentiate and doctoral dissertations, as well as arranged individual special courses.

The degree programme in Mathematics also offers the opportunity to complete the lower BSc degree. The number of BSc graduates has remained low although it would be an excellent intermediate goal for students aiming at the MSc degree. The BSc should be marketed more actively to students. A clear problem in this respect is, however, that working life does not value the BSc degree, because the students' average skills in Mathematics are still insufficient at that stage (one of the reasons being the big share taken up by minor subjects).

The Department of Mathematics offers a substantial amount of instruction in (minor subject) studies to other disciplines, particularly to students of the Physical sciences, Chemistry and Computer science. Minor subject teaching accounts for an average of 45–50% of the Department's credits (Table 1 on p. 10). In recent years, students of Computer science have become the biggest group of minor subject students. This has brought about a change in minor subject teaching, which was implemented in autumn 2001 after lengthy discussions. The Approbatur I and II courses solely aimed at minor subject students were dropped (these courses were originally designed for students of Physics and did not meet the needs of students of Computer science). Minor subject students can now put together a study module in Mathematics (approbatur 15-34 credits, cum laude min. 35 credits, laudatur min. 70 credits) relatively freely using any of the available intermediate-level courses in Mathematics. Students majoring in other disciplines are offered courses specifically designed for their needs, which makes it easier to achieve the goals set for minor subject studies in Mathematics. This also makes it easier to integrate the minor subject teaching of Mathematics with instruction in the major subject.

The degree requirements and curriculum for the following academic year are prepared on the basis of discussions between the professors in charge of the various sub-programme s, the other teachers of the Department, and the members of the steering group. The curriculum is designed to offer a wide range of intermediate and advanced-level courses, to find the best possible lecturers for the courses, and to keep the annually altered range of special courses for advanced and postgraduate studies sufficiently versatile and interesting. The last goal, in particular, is clearly hampered by the insufficient basic funding of the Department.

3. Practical organisation of education

Teaching and study culture

Education in Mathematics has traditionally been based on individual work (such as constructing proofs and solving problems) aiming at achieving personal skills in Mathematics. A central challenge to the teaching in Mathematics (also from an international perspective) is how to construct the lectures to better serve learning and to be more motivating. Students often feel that lectures do not take into consideration the skills and knowledge of an average student: lectures may proceed too fast or the exercises for the problem-solving classes are too difficult. The Department has launched several projects that aim to promote student-orientedness even further than usual (examples include essays in the basic courses of the sub-programme for teachers, a “problem seminar”, and workshop activities). The aim is to share successful experiences with others and attempt to inspire as many teachers as possible by giving them new ideas for their work. Workshop experiences, for example, will be introduced into Differential and integral calculus I during 2001- 02.

Attempts have been made to complement traditional study guidance (course-related problem-solving exercises, supervised groups in Differential and Integral calculus I, study guidance provided by assistants) with new forms of guidance. The Department has experimented several times with teacher tutoring, but the resulting experiences have been controversial (while guidance has met with approval, participants have felt that it may not optimally correspond to the needs of first-year students). The Department plans to implement a supervised problem-solving workshop (the lack of suitable facilities has been an obstacle). The student organisation arranges comprehensive tutor group activities for new students in the first-year autumn, which aim to integrate students into the study community and provide a flexible start for studies.

Nearly all courses have traditionally evaluated learning with mid-term and final exams, which often include extra points collected in problem-solving classes. Evaluation methods now also include essays and seminars, which can be used to complete courses in their entirety or only parts of them.

The nature of the interaction and cooperation between students and teachers depends on the courses and teachers in question. Interaction is closer at the advanced stage of studies than at the intermediate stage, where courses often have more than 200 participants. While the Department’s teachers take care of teaching independently, they work within the course framework familiar to all.

Workloads seem to be in good proportion to the credits awarded in the Mathematics degrees. This issue has not raised any considerable discussion among teachers and students.

Compared to the number of students in the Department, the SOCRATES/NORDPLUS student exchange is relatively small scale (an average of four of the Department’s students annually participate in the programme; the Department has entered into SOCRATES exchange programme agreements with 10 universities and also has one agreement for a teacher exchange programme). Study-related social issues, particularly financing, are the main obstacle to extending exchange activities. The Department

places foreign exchange students (an average of 3/year) as flexibly as possible in the courses they are interested in (the situation will improve as the number of classes held in Swedish and English increases). The same applies to foreign undergraduate students, whose number, however, is small. Foreign postgraduate students are placed directly in one of the research teams. Recognition of studies completed abroad (or elsewhere in Finland) is flexible (thanks to the general similarity between modules in Mathematics).

The Department's teachers have different educational approaches both in terms of their point of view and their specialisation (expertise). In recent years, the Department has had excellent opportunities for educational reforms and experimentations. Ongoing projects include workshop activities and the renewal of educational instruction (for example, in educational psychology) for future teachers. The Department is also involved in research in learning.

Teaching and learning environments

The teaching material in most basic courses consists of lecture notes with widely varying print quality ranging from photocopies of the lecturer's own notes to a textbook given out by a publisher. In some cases, lecture notes have been partly outdated, but their mathematical content is usually of very high quality. There has been a lot of discussion about increasing the use of international (mainly English) textbooks, which would be useful for students' language skills. The disadvantages of using international books include their high price and the difficulty of seamlessly linking their contents. Students have also considered the use of Finnish material to be important particularly at the early phases of studies. The Department is also improving the availability of lecture material on the Internet.

Approximately 1-2 basic courses are held every term in both Swedish and English. The lectures are scheduled so that the course is not lectured in Finnish during the same term. This ensures that the Swedish and English lectures are also attended by Finnish-speaking students (the number of Swedish and English-speakers is relatively small, but experiences of this practice have been positive). Teaching in advanced and postgraduate studies is often provided in English if participants include foreign students. The Department's research seminars are often held in English.

As for teaching tools, the blackboard is generally felt to be superior to many other methods, such as overhead projectors or whiteboards. The Department has launched an ambitious project (including a 5-year professorship) related to the use of computers. One of the problems, however, is the small number of computer labs, caused by inadequate facilities and financial resources.

The aim is to distribute teaching evenly across and within the different terms, as well as over the various days of the week. This is also required by the scarce teaching facilities and their appropriate use. Apart from a few intensive courses, the Department of Mathematics has not arranged any actual summer courses. The Open University offers some basic courses in Mathematics. Summer exams offering students the opportunity to take final exams in all courses are arranged in June and August. The Department also actively participates in the continuing education of subject and class teachers (usually arranged during weekends or in the summer).

The big basic courses are held in facilities outside the Department, some of which are satisfactory (the lecture rooms in Porthania), and others inadequate (for example, lecture room 1 on Vuorikatu 20; the other options being even worse). Smaller intermediate and advanced-level courses are held in the Department's own lecture rooms (four), which are satisfactory as such, although their limited number makes sensible scheduling of teaching groups difficult. Most of the problem-solving classes are held in the four lecture rooms on Vuorikatu 20, which, while equipped with the bare minimum, are located in the vicinity of the Department.

The Department of Mathematics has inadequate facilities, made evident by the crowded office spaces of teachers and researchers (many rooms accommodate 2-3 people), as well as the lack of work spaces for students, in addition to the small number of computer labs. The Department hopes that the move to Kumpula in 2004 will alleviate these space-related problems.

Study progress

Dropouts at the early phases of studies are an internationally acknowledged problem in Mathematics and this is also encountered at the University of Helsinki. According to a survey commissioned by the Department, students who have carried on with their studies for a couple of years are very likely to continue their studies and they do not experience the same kind of problems with their theses as do students of other departments. For several years, the Department has focused its attention on the decisive first-year studies and tried to find the best and most motivating teachers to hold lectures. It has also attempted to take the average students' starting level better into consideration (the problems of Mathematics teaching in Finnish upper secondary schools have weakened the skills of new students). The Department has recently focused on the main problems of first-year studies, which has already produced good results (Appendix). The new admittance procedures introduced in 2000 helps select students who are more committed to studying Mathematics.

It is relatively common for students of Mathematics to work while studying, particularly towards the end of their studies. While this lengthens the average graduation time, it also provides students with essential work experience.

Values of the teaching, learning and academic community

The scientific skills of the personnel as far as Mathematics is concerned are of top quality: the Department has done very well in research evaluations (maximum grade 7/7 in the evaluation of research at the University of Helsinki, evaluation of the field of Mathematics carried out by the Academy of Finland in 2000). Students have often given positive feedback on the expertise of the teachers, but have been more critical about their inspirational and motivational skills.

As stated in the regulations of the University of Helsinki, all teachers do research (produce and transmit new information) in addition to teaching. The emphasis on research and teaching merits when recruiting teachers depends on the requirements of individual posts. Administrative tasks related to departmental routines have clearly increased in the past years and are unevenly distributed among staff. The department aims to distribute the supervision of theses in both undergraduate and postgraduate education more evenly among personnel.

The development of education also aims to help students cope with and commit themselves to their studies. However, students have traditionally felt that their chances to influence things are relatively limited.

Owing to the cumulative nature of Mathematics, it is difficult to create connections between basic education and the research carried out in the Department. One of the Department's goals is to include students in the activities of research teams. As participation in research seminars is often hindered by the high level of skill required, the Department has successfully tested "student seminars" and free study circles.

Postgraduate studies

The Department of Mathematics has approximately 130 postgraduate students, some 70 of whom have handed in their postgraduate study plans in the past three years. Of these, some 35 can be considered full-time postgraduate students (Appendix). In terms of supervision, the Department clearly has the capacity to increase the current number of graduates (Appendix), and is aiming at this, for example, by integrating (postgraduate) students more closely into research teams and seminars. Supervisory activities are distributed unevenly among personnel (a more even distribution would be more appropriate). For example, younger researchers can rarely offer paid project work to postgraduate students. In addition, dissertations consisting of several articles published in academic journals should be more emphatically recommended in Mathematics in addition to the traditional monographic dissertations.

A problem group among postgraduate students consists of those working elsewhere in addition to their studies. Their contacts with the supervisors and research teams are often loose and their studies also proceed more slowly. Interruption of postgraduate studies is also a definitive problem, as students have switched to employment outside the university: the salaries offered by universities are not competitive.

4. Evaluation and feedback

Course-specific feedback given at the end of courses has been used in Mathematics since the ‘80s, with the Mathematics student organisation, *Matrix ry*, usually collecting the results. Feedback has influenced course planning and the development of teachers’ personal teaching skills. In spring 2001, the Department implemented an electronic feedback system. Students have also hoped for feedback surveys in the beginning and middle of courses. This would enable students and teachers to better address possible problems while courses are still going on. The students also hoped for a bigger number of open-ended questions so that they could comment on specific mathematical difficulties and problems connected to the courses.

No department-wide feedback has been systematically collected from recent graduates or employees. The employment situation of mathematicians is excellent: according to a survey conducted by the Faculty, all recent graduates in the field have found employment. The research teams and postgraduate education in the Department of Mathematics were evaluated in 1999 (University of Helsinki) and 2000 (study carried out by the Academy of Finland focusing on the field of Mathematics in Finland). Both evaluations offered a variety of ideas for the development of the Department’s postgraduate education.

In 1998, Juha Oikkonen was rewarded with the highly esteemed *Eino Kaila* award given to the best teacher of the University. In 2000, Marjatta Näätänen received the Mathematics award granted by the Academy of Finland for her work on awakening interest towards Mathematics among girls, as well as the *Maikki Friberg* award for promoting equality at the University of Helsinki.

5. Future prospects and development plans

Versatile skills in Mathematics and mathematical methods are of core importance in society. The need for education in Mathematics will continue to increase as more profound mathematical methods are introduced. The employment situation of skilled mathematicians will remain good.

In 2001, a plan was presented to integrate the Department of Mathematics, the Department of Statistics and the Rolf Nevanlinna Institute on the Kumpula campus in 2004. Many surveys have proposed the integration of the departments of Mathematics and Statistics as is common in other countries. Integration could lead to synergy benefits in teaching and it would support the teaching provided in stochastics, as well as financial and insurance mathematics. The Department has a favourable attitude

towards such integration although it would lead to both administrative and practical problems concerning the minor subject teaching provided by the departments.

The development plans in the Department of Mathematics focus on the following issues:
- Developing teacher training in Mathematics, particularly in the case of major subject students but also concerning the education of class teachers
- Expanding the course offering in applied mathematics, particularly in financial and insurance mathematics
- Developing workshop and small group teaching (the basic resources of the Department are not sufficient for this)
- Making postgraduate education and supervision more efficient

6. Summary

STRENGTHS
- Versatile teaching and skilled personnel
- International top-quality research in many subfields of Mathematics
- Flexible structure of degrees
- Good employment opportunities for mathematicians
- Good competitiveness in funding of projects and research schools
- Good and up-to-date library

WEAKNESSES
- Relatively high share of dropouts at the early stages of studies
- Motivational problems in the teaching of Mathematics
- Insufficient number of computer labs and IT equipment for teaching
- Integration of postgraduate students into research seminars
- Insufficient number of postgraduate degrees
- Small number of post-doctoral research positions
- Crowded work and study spaces

THREATS
- Insufficiency of budget funding
- Poor visibility and valuation of Mathematics and studies in the discipline
- Weaker initial skills of new students (on the average)
- Increased part-time nature of studies
- Recruitment of younger teachers and researchers

OPPORTUNITIES
- Trend towards more efficient and versatile teacher training
- Direct entrance system for teacher training
- New ideas concerning teaching methods
- Focus on new fields in the teaching of mathematics (for example, financial mathematics and risk theory)
- New cooperation opportunities with the IT sector
- Increase in the number of students interested in Mathematics
- Increasing demand for mathematical skills
- Plan to integrate the Departments of Mathematics and Statistics on the Kumpula campus in 2004

Reference

Matematiikkalehti Solmu http://solmu.math.helsinki.fi

Table 1

Students in Mathematics

New student admission:

1996: 257
1997: 212
1998: 201
1999: 180
2000: 201

Students having Mathematics as their major subject:

1996: 1222
1997: 1184
1998: 1135
1999: 1153
2000: 1143

Teaching in the Department of Mathematics (measured in credits):

1996: 12403
1997: 11267
1998: 13331
1999: 13074
2000: 14715

SELF-EVALUATION REPORT OF THE PHYSICAL SCIENCES

The Physical Sciences degree programme includes the sub-*programmes* of Physics, Physics teacher, Geophysics, Meteorology, Theoretical physics and Astronomy. Except for Astronomy, the teaching and other activities of the sub-programmes and specialisation areas take place in the Physicum building, which is common to the whole Department of Physical Sciences and located on the Kumpula campus.

The first-year studies of all sub-programmes include basic studies in Physics and Mathematics, after which the studies of Geophysics, Meteorology and Astronomy are differentiated. As the Physics, Physics teacher and Theoretical physics sub-programmes still have much in common after this, they will be dealt with together in this report. In the first section, Department will therefore only refer to these three sub-programmes instead of the whole Department of the Physical Sciences. Geophysics, Meteorology and Astronomy will be dealt with separately afterwards.

The part on *Physics, Physics teacher and Theoretical physics* was prepared by a workgroup including Kari Eskola, Professor; Björn Fant, Senior Assistant; Ismo Koponen, Senior Assistant; Seppo Manninen, Lecturer; Jouni Niskanen, Senior Assistant; Heimo Saarikko, Professor; and Walter Rydman, student. The part on *Geophysics* was prepared by Matti Leppäranta, Professor; and Lauri Pesonen, Professor, *Meteorology* by Noora Korhonen, student; Sami Niemelä, Assistant; Kimmo Ruosteenoja, Senior Assistant; and Hannu Savijärvi, Professor, and *Astronomy* by Lauri Jetsu, Docent; Peter Johansson, MSc; and Kalevi Mattila, Professor.

I The sub-programmes of Physics, Physics teacher and Theoretical physics

1. Planning, aims and content of education

A. Educational mission and the aims of the degrees

Under- and postgraduate education in Physics is offered in two disciplines: Physics and Theoretical physics. The Physics teacher education follows a separate path after the second year of studies. Education in the three sub-programmes aims to

* Develop experts capable of independently developing and evaluating new information in their field
* Meet society's needs as indicated by research and feedback received from working life
* Raise Finnish skills in Mathematics and the Natural Sciences to a high level on an international scale in accordance with the goals of the country's government programme
* Implement measures that are in line with the University's strategy and that aim to develop an atmosphere which inspires high-quality learning and teaching
* Increase the number of undergraduate degrees as agreed with the Faculty.

The education for Physics teachers also needs to take into consideration the needs of schools and subject didactics.

Education in Physics provides the skills to understand and promote the fast development of information and technology in modern society. It also offers comprehensive and versatile skills to apply Physics in various fields. This can be seen in the good employment situation of physicists both in professions directly corresponding to their education as well as in other jobs. Since the labour market could currently employ more physicists than are available, no risk of excess numbers of physics graduates is in sight.

B. Influence of the aims on the degree structure and degree requirements

The degree structure offers the basic education necessary for physicists, based on which students specialise during the two last years of studies in accordance with the goals of their *specialisation areas*. However, the choice between general physics and theoretical physics introduces variation into the basic education due to the different emphasis that the two paths place on formalism and experimental work. As a part of specialisation, students write their theses on topics related to the work of a research group. This provides students with the opportunity to obtain a wider picture of their special field as members of a research community. Students studying to become teachers usually write their theses on topics related to the teaching of Physics, based on the latest research.

The Department also offers extensive minor subject teaching in Physics, Theoretical physics and Physics teacher studies. Part of these studies is designed jointly with other exact sciences. Cooperation with the Biosciences is also being discussed. The Department arranges courses in the basics of Mathematics and Computer Science, which are needed in the studies of Physics. Theoretical physics, for example, offers physicists and other natural scientists sufficient general and practical skills in its courses on Mathematical Methods.

The degree requirements and curriculum are prepared in the Development working group for teaching, which also has student representation. Preparations use feedback from graduates and proposals made by students. Physicists that have left the Department and moved into working life are also used as teachers in special fields (IT, Medical physics).

The Physics teacher degree includes studies in subject didactics and a teacher training period arranged by the Department of Teacher Education. The Department offers a special 20-credit study module in educational physics, which has been successfully used in the continuing education for teachers (LUMA). The studies for teacher trainees are designed jointly by the Department of Physics and the Department of Teacher Education. The education offers teacher qualifications for various educational levels.

2. Practical organisation of education

Teaching and study culture

Teaching in the early and middle stages of studies is mainly offered as lectures. Student-orientedness and the benefits of small groups are enjoyed in problem-solving classes and laboratory work, both of which are essential parts of courses. Teachers are also available for discussions and students can get personal feedback on exams. Advanced-stage studies also include seminar work.

In addition to traditional contact teaching and small group studies, the Department is also developing Web-based teaching and remedial instruction for first-year students. This is enabled by the Faculty's support and the experiences have been good so far. Additional resources and further training of the teaching staff are required to continue activities. There are not, for example, enough teaching resources in the academic year 2001-2002 to make full use of the network environment in teaching.

Instruction in teacher training, in particular, is based on small groups, discussion and dialogue. It is based on the active participation of students and an essential part of course completion consists of the planning, monitoring and self-evaluation of one's own studies and learning. The goal is for students to learn how to evaluate themselves, the progress of their studies and their own contribution to courses.

This is good practice for the self-evaluation and planning of work that are characteristic of school environments.

The Department's study guidance involves student and teacher tutors providing guidance to first-year students, personal supervisors in research education, and the Department's student advisers. A recently conducted outside evaluation of study guidance showed that students were satisfied with the guidance offered. Possible development projects involve the expansion of personal guidance and monitoring of studies in research education, and the drive to make computers an inherent part of new students' studies.

The Department has entered into 16 bilateral Erasmus agreements and it is an active user of the Nordplus network for theoretical physics. To facilitate international activities and exchange programmes, the Department uses the ECTS credit system to evaluate studies and transfer them between countries. A study plan based on the curriculum of the target university is drafted with the exchange student to ensure that the studies in the foreign university can be recognised as fully as possible. The number of foreign students at the Department is on the increase. Exchange students take part in the Department's basic education, and more advanced students can also take part in project work in research groups.

Teaching and learning environment

The teaching material consists of Finnish textbooks written by the Department's personnel, as well as other literature, which is mostly in English. The new facilities that the Department moved to in spring 2001 (Physicum) enable efficient use of modern technology, including versatile audio visual equipment, modern computer labs and a library offering a multitude of services. The Department has invested in demonstration equipment and the recruitment of personnel with the required expertise to operate the equipment. The laboratories and computer labs are located close to the lecturers' offices, leading to closer and more constructive interaction between supervisors and students.

In addition to Finnish, the languages of instruction include Swedish, which can be used throughout undergraduate education, and English, which is growing more important as the number of foreign students increases. Many courses, especially in the advanced stage, are offered in English, as needed. This has become more of a rule than exception in Theoretical physics, which is particularly popular among foreign students. In basic education, Finnish students are entitled to instruction in their mother tongue, but English material, especially textbooks, are recommended. Some instruction is also held in English by exchange teachers and visiting researchers.

The teaching laboratories used as the learning environment for experimental work have better resources in the new facilities. This is particularly true of the lab for intermediate studies, which has new equipment for basic experiments in modern physics. The teaching laboratory for teacher training, whose equipment has already been modernised, has served as a model

The Department has divided the academic year into two periods in the autumn term, two in the spring term and one in the summer. While the summer term offers hardly any lectures, the laboratories are held open, three exam opportunities are offered and students at the latter stages of studies can work in research groups.

Special groups in terms of teaching include students in working life (such as teachers) and students incapable of normal studies due to physical restrictions. The Department tries to arrange lecture courses for teachers in the evenings and is also working on developing Web-based teaching. Individual special

arrangements to facilitate the completion of studies (for example, sending assignments by e-mail) have been arranged as needed.

The progress of studies suffers from the widely differing initial skills of students, particularly in Mathematics, and the fact that the good employment situation pulls many students into working life before they have a chance to graduate. First-year students also include those that use the instruction offered by the Department as training for the entrance exams of other faculties or universities. A survey on the study progress of first-year students was carried out with the support of the Faculty in the academic year 2000-2001. Students that exhibited weak progress were contacted in person and a realistic study plan was prepared for them.

Values, quality and atmosphere of the teaching and learning community

In line with the nature of university activities, academic qualifications are the primary criteria in staff policies. The importance of educational skills has received more emphasis in recent years: applicants for posts must now also present an account of their teaching merits. Apart from teacher training, the staff's pedagogic training is relatively limited and mainly based on the staff's own activity. When recruiting teaching personnel, more importance should be given to the applicant's teaching experience and verifiable qualifications as a teacher. Opportunities of further training and familiarisation with the latest educational information should be offered for the teaching staff, ensuring that such opportunities are flexibly interspersed with the staff's other teaching tasks and research work.

Students' commitment to the Department usually does not start until the third year when minor subjects are mostly completed. At the early stages of studies, most students commit themselves to student organisations and associations. The first year does not provide a good environment for the development of solidarity, as many students at that phase are planning a career change. Later on, work as an assistant in problem-solving classes and as a summer worker and later as a thesis writer working in research groups quickly ties students to the Department. The researcher education option established in 1996, in which the Department's teachers act as individual supervisors for each student, ties students to the Department from the very beginning of studies. Some 20 students aiming at a postgraduate degree are annually selected for the research option.

At the later stages of studies, nearly all students work in research communities (research groups or research institutes outside the Department). Research groups could currently offer even more employment opportunities to students. The link between research and studies exists from the very beginning of studies, since active researchers act as teachers.

The Department has aimed to improve staff satisfaction by arranging annual events, such as seminars held on passenger ferries, visits to the theatre, and Christmas parties. The Department's atmosphere is good and both the teaching and research staff are well committed to their work. Students have also expressed their satisfaction with the Department, and especially the students' common room. Interaction between the Department's staff and students is smooth and unreserved.

Intra-departmental, domestic and international cooperation in education and studies

The structural content of studies in exact sciences and the related knowledge required in mathematics and computer sciences offer a natural starting point for teaching cooperation between these disciplines. Cooperation will become considerably easier when all the departments are located on the same campus. Teaching cooperation has also been developed with the Helsinki institute of physics (locating in Physicum) and the Helsinki University of Technology. National Graduate Schools have increased national cooperation related to postgraduate studies, the biggest benefit being the increased versatility

of the course offering. For example, some courses in environmental physics and chemistry could hardly be arranged without inter-departmental cooperation. The use of existing teacher resources can also be made more efficient as overlaps decrease.

The Department has three Sokrates teacher exchange agreements, which have to some extent increased the amount of teaching held in foreign languages. The biggest benefits lie in the special fields and expertise incorporated into teaching. These activities have been most fruitful in cases where a research connection has already been established and cooperation has simply been extended to teaching. In these cases, teaching exchange is just a small addition to existing and planned activities and connections, but the results are best in such natural settings. Teaching exchange is usually of short duration, which complicates the evaluation of learning (for example, the organisation of exercises and exams).

In addition to the exchange programme, the Department is involved in the EU-supported thematic Sokrates network, European Physics Education Network (EUPEN), and in the physics work group of the EU pilot project Tuning Educational Structures in Europe. These projects enable the Department to participate in the international development towards more uniform degree structures as well as to influence the final results.

Practical training

The degree requirements in Physics do not include practical training, but work at the advanced stage, such as laudatur papers and theses, are often completed in laboratories outside the Department or in the industry. The Department can offer summer traineeships in public administration, which often lead to permanent employment.

Postgraduate studies

The Department is involved in several national research schools (Material physics, Particle and nuclear physics, Astronomy and space physics, Modern optics and photonics, and Teacher education). Students aiming at postgraduate studies are usually recruited into research groups at the latest when working on their thesis. Postgraduate studies include a minimum of 40 credits of additional studies, at least 20 of which must be in Physics or Theoretical physics. Each postgraduate student gets a personal supervisor for the dissertation.

Postgraduate studies are a natural option: a general opinion among experimental and especially theoretical physicists is that the MSc degree is only an intermediate step, the ultimate goal being a PhD degree. Recruiting postgraduate students in subject teacher education is usually more difficult, because graduates usually transfer directly to working life. The licentiate degree has been developed as a postgraduate degree for teachers already working in their profession.

Quantitative results

The number of degrees has clearly risen since the early 1990s. The Department and the Faculty have agreed on the target number of degrees up to 2003. The goal in 2001 was to achieve 54 MSc degrees and 18 PhD degrees. In addition to quantitative goals, the Department aims to shorten the time to graduation. The median age of MSc graduates during the five-year period 1996-2000 was 26.3 years, which was over one year less than during the previous five-year period. The corresponding figures for doctoral degrees were 31.3 years (32.7 years). The University has also launched a campaign aiming at increasing the number of graduates by requiring students with over 10 years of studies to prepare a study plan for the completion of their degree before they are allowed to register at the University.

Learning results

Students' learning results are usually evaluated using a traditional exam or with 2-3 mid-term exams. Continuous assessment is also carried out in problem-solving classes where students hand in their solutions beforehand to be verified.

The Department has prepared common instructions for thesis writers. At the beginning of the academic year 2001, the Faculty of Science gave the Department of Physical Sciences the right to decide on the grades of theses completed in the Department. The goal now is to create intra-departmental instructions, with the aim of making grades more uniform. Since nearly all theses are part of the more extensive work of a whole research group, internal control of the team improves the quality of the work – and consequently the grades of the theses.

The studies in Physics teacher education mainly evaluate learning results using quantitative methods based on the students' reports on practical assignments and other output prepared as group work. Self-evaluation is also used for assessing learning results. Based on student feedback, the skills of teachers have developed considerably during courses as has the students' understanding of Physics and its information structure.

3. Evaluation and development of education

Feedback systems

Students can use a Web-based system throughout the term to send comments on courses. Teaching can be evaluated after course-end using a numerical feedback form in electronic format. Feedback from first-year courses has also been collected using paper forms. Although the Web-based system is easy to use, the response percentage has remained very small. As the new Department of Physical Sciences initiates operations, the best feedback practices of the merging departments should be selected to form new practices.

Feedback is easier to obtain in small groups. For several decades, the Swedish-speaking unit has maintained a so-called studiekollegiet system where students and teachers handle feedback for individual courses at discussions arranged three times a year. In teacher education, student feedback is collected throughout the duration of courses, partly orally and partly in writing, and the feedback is used when planning and implementing instruction. A joint feedback discussion is held at the end of the course to evaluate teaching and learning, after which teachers still receive feedback in writing. Although the system requires a significant contribution from students, it is felt to be useful because students believe it has affected the content and practical organisation of education.

The Faculty collects feedback on teaching and studies with an evaluation form distributed to students while they are completing their degree. A summary on the feedback during 1996-2000 has recently been published by the Helsinki University Career Services. According to the students of Physical Sciences, the best aspects of the degree programme include the development of students' opinions and ways of thinking into a natural-scientific world view. The Department also maintains contacts with its alumni, for example, by sending them the Department's annual report and by requesting feedback on the education provided by the Department.

In the mid-1990s, the Faculty carried out a survey among the alumni concerning their employment. More current information, however, has been obtained from an EU pilot project "Tuning Educational Structures in Europe", which the Department is involved in. The project is true to the Bologna

declaration and the related survey was conducted in June among people that had graduated from the Department in recent years, as well as among the biggest potential employers. The survey reviewed the professional suitability and employment potential of the teaching and degrees offered by the Department, as well as the characteristics required by working life and the extent to which these characteristics are obtained through studies. The results show that Physics graduates are generally speaking satisfied with the professional skills provided by their degree. Most responses also indicated that the respondents had found employment corresponding to their education in a variety of fields.

Students find the course feedback system to be a comprehensive method consisting of various parts. An important aspect is the grading and verification of problem-solving exercises which assistants carry out prior to the problems being reviewed in class. Students also feel that mid-term exams give good feedback on their skills while courses are still underway. Assistants supervising laboratory work return the laboratory reports with their comments to the students. This is felt to be a good practice.

Students agree that course feedback from students to lecturers does not work well. They also feel that feedback procedures in the research option need to be improved. Supervision at the early phases of study could be arranged in bigger groups and the appointment of a personal supervisor could be postponed until the beginning of the third year, at which point students already have a clear picture of their specialisation option. Another alternative would be to appoint postgraduate students as first- and second-year supervisors. This model would also postpone the appointment of a personal supervisor until the third year.

The Department's teaching development team reviews the feedback, based on which it prepares a proposal for the steering group concerning the revision of degree requirements and the curriculum. For example, the credit allocations of different courses have been reviewed mainly on the basis of student feedback.

Recognition and awards granted to teaching

The Department's students annually elect a *Teacher of the Year*, who is rewarded with a certificate of honour and a challenge trophy. An *Assistant of the Year in problem-solving classes* is also elected. The Department's teachers and researchers have also been successful as authors of textbooks and non-fiction books. The quality award granted by the University in 1999 also emphasises the Department's systematic work towards developing education. As a material incentive, teachers' salaries can be supplemented with a fixed-term productivity bonus.

Past or ongoing extensive development projects

Supported by the Faculty's development committee, the University and the Ministry of Education, the Department has launched, for example, the following projects:

- Development of teaching in Environmental physics and chemistry (joint project of the Departments of Physics and Chemistry)
- Development of teaching in Materials science (joint project of the Departments of Physics and Chemistry)
- Instruction in the basics of library and IT skills (joint project of the Kumpula campus)
- Survey of the current status of teaching in Physics and Chemistry and integration of teaching as applicable
- Development of teaching in Biophysics (joint project of Physics and Biosciences)

- Development of Physics teacher education
- Further education for teachers supported by the Ministry of Education)

4. Future prospects and development plans for education

The lack of secondary school graduates who have completed the more extensive options in Mathematics and Physics is common to many Finnish universities. In a competitive situation like this one, the visibility of our Department at schools should be developed as efficiently as possible. The key to solving this problem is the development of teacher education in the field. In recent years, studies in teacher education have been systematically developed using the special appropriations of the LUMA project, for example, by arranging special courses for Physics teachers, which are not part of other researcher education. The positive feedback received from the educational reforms along with the recent increase in student numbers provides good grounds for continuing the LUMA project. The Department could also be made more interesting by improving the design of its homepages, including, for example, the often proposed *Ask the physicist* feature.

Increasingly more information is obtained on the Internet. This has increased the need for an academic writing course dealing with modern methods used to search information, text processing, and instructions for Internet searches. Experiments have been made in teachers' and students' small groups to improve oral presentation skills. These experiments should be made into established practices. The Department has also tested IT-based self-controlling alternative teaching methods. Content production is essential to Web-based teaching. The material must not be merely a text transferred to the network; it must truly make use of the opportunities provided by networks. Hypertexts are a good example of such material. Other requirements include easy updating. Virtual university activities are actively developed, especially in the context of teacher traing, both at the University of Helsinki and within the national virtual university. The Web-based material used in the laboratory course of teacher education has received positive feedback and may serve as an example in the future.

Development projects implemented in cooperation with mathematical disciplines are described in the common part at the end of the report.

II The sub-programme of Geophysics

Geophysics is a field of geosciences that studies natural conditions on Earth from a physical point of view. Geophysics is taught at the Universities of Helsinki and Oulu, while the Helsinki University of Technology offers applied geophysics. Research in Geophysics is characterised by field observations and samples, which is why part of the education takes place at biological stations and elsewhere in the field. Laboratory work will start in the Solid Earth specialisation area of Geophysics when the new laboratory is finished.

Education in Geophysics provides good capabilities for environmental research, indicated by geophysicists easily getting employment in tasks corresponding to their education. Since the labour market could offer employment to even more graduates of geophysics, there is currently no risk of educating too many students. The Department's current quantitative goals are three annual MSc degrees and three doctoral degrees, but there is pressure to increase both figures by one.

An essential part of the degree structure consists of *basic education*, in which students select between the *Solid Earth* and *Hydrosphere* specialisation areas. The Department of Geophysics also offers extensive minor subject teaching in Geology, Meteorology, Geography, Physics, Chemistry, Mathematics, Hydrobiology and Limnology. Common courses have been held with the disciplines of

Meteorology, Geology, Hydrobiology and Plant Physiology. In small disciplines, such as Geophysics, participation in international degree programmes becomes topical at the advanced stage of studies or in postgraduate studies, as small divisions cannot offer a wide range of courses. Joint Nordic courses have traditionally been held in Hydrology and Oceanography, and these activities continue to be active. Financing has been provided, among others, by NorFA. Since 1999, the Department has also been involved in an EU programme concerning teaching in Glaciology. Intensive courses for advanced stage and postgraduate students have been arranged in international cooperation. These courses have included foreign students and teachers as teaching has taken place in English. Many students specialising in Glaciology spend 1-2 terms at the Spitzbergen (Universitetstudiene I Svalbard), supported by Nordplus. In addition, students have taken part in courses supported by the EU and ESF in different parts of Europe.

Evaluation and development of education

Maintaining the basic education in the field is the key task of the Division of Geophysics. A considerable part of instruction is given as fee-paid teaching by *docents* and *special teachers*. In addition, Geophysics, a small field to start with, has been divided into subfields, such as Seismology and Geodesy, which require special education and which the Department itself can offer only to a limited degree. Notable development has taken place in the last five years:

* The Ministry of Education granted financing for the Snow and Ice Graduate school as of 1999.
* The first Professor was appointed to Solid Earth Geophysics on April 1, 2001.
* Teaching in the Solid Earth and Hydrosphere options has been combined where appropriate.
* Basic training in Geophysics has been arranged for upper secondary school teachers of Physics and Geography.
* A teaching and research laboratory for Solid Earth Geophysics has been established in Kumpula.

Future prospects and development plans for education

The Department of Physical Sciences was established and the Department of Geophysics incorporated into it on August 1, 2001. A major concern in the near future is how to integrate the sub-programme of Geophysics into the other physical sciences without putting the content and quality of teaching at risk. When working on the Department's development plans, the following should be taken into consideration:

* *Continuity of teaching in small fields of Geophysics*: How can teaching in small fields, such as Seismology and Geodesy, be kept up, as this has so far mainly been taken care of by docents and special teachers of research institutes in the field.
* *Maintenance of field education*: Field education is more expensive than teaching offered in classes and laboratories, but it is necessary for students of Geophysics. Field courses have also attracted good students to the field; the courses help talented students (who are interested in Mathematics and Nature) find Geophysics.
* *Establishment of international education*: Nordic cooperation aims to create a degree programme for advanced and postgraduate studies in which the different Hydrosphere units would take responsibility for their own special fields and would arrange intensive courses in them.
* *Laboratory for mathematical models*: One of the problems in the teaching of Geophysics is mathematical models. Although they are used extensively in Geophysics, no good educational programmes are

available.

Education concerning models would include numerical analysis, time series analysis, computer science and geophysics. Until now, such education has concentrated too much to applications, at the expense of a comprehensive understanding of the field.

* *Hydrolaboratory in teaching*: The hydrolaboratory has not been used adequately in courses of fluid dynamics and other Hydrosphere courses. This is largely due to the fact that Finland has no researchers in the physics and geophysics of fluid dynamics laboratories, and the number of basins as well as information on teaching demonstrations and laboratory work has remained scarce. Putting the hydrolaboratory to more efficient use in teaching and having students participate in laboratory work will considerably improve the level of knowledge of the hydrosphere.

* *Ice laboratory in teaching*: The Division of Geophysics aims to acquire an ice laboratory, which is to be used in much the same way as the hydrolaboratory in teaching.

* *Geophysics laboratory of Solid Earth in teaching and research:* To support teaching and research in Geophysics, the Division of Geophysics is building a laboratory, which can accommodate practical exercise groups in Solid Earth Geophysics and Petrophysics. One of the problems in this respect is the insufficiency of the current facilities and their unsuitability for student work. The best solution would be to reserve the current laboratory for student exercises and try to find new facilities for research and the top-quality instruments required by it either in the future rock-embedded facilities of Physicum, or in the fourth-stage facilities at Kumpula.

III The sub-programme of Meteorology

The degree structure in Meteorology resembles that of Physics. Because the vast field of Meteorology has been divided into several subdivisions and studies incorporate both obligatory and optional courses, most of the studies in Meteorology consist of courses with a scope of 2 credits.

An important tool in planning the curriculum for each academic year is the survey conducted by the student organisation Synop ry, inquiring into the courses that students would like to participate in the following year. Despite the lack of resources, the most important courses in terms of study progress (including Basics in Meteorology and Dynamics I-III) have been held every year. Most of the other obligatory courses have been arranged every two years while optional courses have been offered even less frequently. By focusing on planning and listening to students' wishes, the limited amount of teaching has been optimised so that no one's graduation has been considerably delayed.

1. Practical organisation of education

Most of the courses in Meteorology are completed in the traditional way: lectures, problem-solving classes, independent study and either a final exam or two mid-term exams. In most courses, the number of problems solved in problem-solving classes also affects the approval and/or grade of the course. For the purposes of scheduling exams, students answer a questionnaire, the results of which are used by the study coordinator to find suitable times. Laboratory courses have no final exam; instead, they are graded on the basis of active participation and work descriptions or final reports. Studies also include a seminar course in which students hold two presentations.

Thanks to the small size of the division, the relationships between students and teachers have been good and unofficial discussions provide a lot of feedback. Ever since the 1970s, official feedback has been collected from students using a form distributed to them in connection with final course exams. Negative feedback has sometimes resulted in the teacher being changed.

Information on teaching can be found in the teaching programme, on bulletin boards and on the division's Web pages. Another excellent channel is the student organisation's e-mail list which the study coordinator uses to send topical announcements. Old exams can be found in the reference library.

According to student feedback, the educational skills of teachers are usually at least reasonable, in some cases even excellent. Students of Meteorology have a clear image of their profession and teaching plays a significant part in the division.

Owing to the small number of staff, teachers of Meteorology must also get acquainted with subfields of Meteorology other than those related to their own research. This has further increased the heavy workload of the teachers in our division, the only university-level unit of Meteorology in Finland, as has continuing education and other further training.

Most courses follow a Finnish course compendium prepared by the teacher. Many teachers prepare the notes with great care, practically achieving the quality of textbooks. Less refined material in some courses has been improved on the basis of student feedback. If the course textbook is in English, teachers usually provide a small course-specific English-Finnish glossary for students.

The MSc degree in Meteorology includes three obligatory written papers: preliminary essay (1 credit), BSc research paper (3 credits) and the thesis (20 credits). Outside experts have been used particularly as thesis supervisors. Despite this, teachers often end up supervising research in fields in which they have only limited expertise: Meteorology is an extensive field, and the knowledge of a small teaching staff cannot cover all of it.

Essay-writing and thesis-work is taught at a special supervisory lecture, in addition to which students get a free 12-page booklet on preparing written papers. The booklet is not a mere collection of formal rules; it has been created to truly support and help students write their papers. A 137-page meteorological dictionary was also prepared for students in the early 1990s, including Finnish and Swedish equivalents for English terminology.

The employment situation in Meteorology has long been very good. As a considerable number of students work while studying, their studies are slowed down and the number of graduates declines.

2. Future prospects and development plans for education

Plans for the near future include evaluating the degree requirements in Meteorology as a whole, including both the major and minor subjects. Issues to be discussed include the following:

* Efficient use of the expertise of old and new teachers, as well as more efficient recruiting of outside teachers
  for instruction purposes
* Do the courses teach the right things? Are some fields left undealt with or do overlaps occur?
* Are student workloads in proportion with the credits awarded for courses?
* Development of study material especially in courses with weak material
* Planning of an appropriate 15-credit minor subject module
* Development of more versatile exam practices
* Inclusion of a variety of teaching methods: field courses, process learning etc.
* Development of Chemical Meteorology

IV The sub-programme of Astronomy

1. Practical organisation of education

Education in Astronomy is divided into basic education (basic and intermediate studies) and advanced education (advanced and postgraduate studies; MSc, Licentiate and Doctoral degrees). All *basic education* is taught on the Kumpula campus. This makes it easier for major and minor subject students to take part in instruction offered in Physics, Theoretical physics, Geophysics, Meteorology and Chemistry. The instruction in Mathematics and Computer Science, two other important minor subjects, will also move to the Kumpula campus in the near future.

Two of the Department's basic courses, "The Universe now" (2 credits, with some 200 students in autumn 2000) and "Basics in Astronomy" (3 credits, with some 110 students in spring 2001) keep attracting more students. These two courses will also be taught on at least five different occasions this academic year to some 60 students at the Open University. Both courses are mainly based on the textbook *Tähtitieteen perusteet* (*Fundamentals of Astronomy*) compiled by some of the Department's teachers. The English and German translations of the book, published by Springer Verlag, are also used at many foreign universities. Both courses attract students from a variety of the University's faculties, because they teach the basics of the modern worldview of exact sciences.

Student numbers in other basic courses are smaller (20-30 students), because they have been designed particularly for major subject students of Astronomy. Minor subject students can put together their study module using any optional courses in Astronomy. The new course "Practical Methods of Astronomy" provides students with basic skills in numerical calculation, programming, and the use of databases and other applied methods in Astronomy.

Group sizes in intermediate studies range from 5-20 students. These courses are also taught on the Kumpula campus, as more than half of the participants are minor subject students.

Advanced studies are taught at the Observatory, where the lecture hall and recently finished computer lab enable efficient teaching. The groups are small, with only 5-10 students, and studies are closely linked to the research carried out in the Department. Thanks to small groups, students can be offered personal guidance, including theses related to research projects pursued in the Department. Advanced studies focus on researcher education, because the "basic degree" in Astronomy is, in practice, the Doctoral degree. For example, all MSc graduates in 1995-2000 continued postgraduate studies and research aiming at a Doctoral degree. The Department was involved in two national Graduate Schools

in 2001. Because the number of postgraduate students has increased considerably in the past years, the Department aims to renovate the workshop facilities with a surface of 70 m² as workspaces for postgraduates.

2. Evaluation and development of education

The period 1995-2000 produced an annual average of 1.5 MSc degrees and one doctoral degree. Combining this ratio (1/1.5=2/3) with the annual goal of four MSc degrees set for the Department leads to an unrealistic situation in view of the labour markets for astronomy. Taking into account that those with a doctoral degree have a career of some 30 years, the University of Helsinki alone would account for 30x4x2/3=80 doctoral degrees in Astronomy. Fifteen of the Department's current staff have completed the doctoral degree. The Department's increasing research in Astronomy, Finland's ESA (European Space Agency) membership, as well as the country's pending ESO (European Southern Observatory) membership may lead to a maximum increase of 20 in the number of jobs for Finns holding a doctorate in Astronomy. A realistic conclusion, therefore, is for the Department to set its short-term goals at three annual MSc degrees and two annual Doctoral degrees.

Another alternative is to concentrate more on the MSc degree in the future. Unfortunately, the MSc degree in Astronomy does not qualify students as teachers of secondary and/or upper secondary school as do the corresponding degrees in Physics, Chemistry and Mathematics. Advanced studies in Astronomy offer excellent skills in data, image and content processing, as well as various theoretical modelling tasks, and are thus likely to open job opportunities for some MSc graduates, for example, in the IT sector.

3. Future prospects and development plans for education

The number of major subject students in Astronomy is small. To increase the number of degrees completed, the number of major subject students needs to be raised and studies have to be more efficiently supported, particularly at the beginning of studies and during thesis work. This has been thoroughly discussed among all of the Department's personnel groups and concrete measures have already been taken. Since autumn 2001, some of the older major subject students have taken an active part in the tutoring of new major subject students. Since spring 2001, each major subject student has been appointed a personal teacher tutor who is one of the Department's employees with a MSc, Licentiate or Doctoral degree. Teacher tutors help students with various study-related problems and questions. In the future, the Department also plans to focus more on the information on Astronomy communicated to upper secondary schools.

The Department's high-quality research, mainly financed with outside funds, is the basis for the continuity and quality of teaching. According to the atmosphere survey carried out in autumn 2001, the Department has a good teaching and research atmosphere, which will be further enhanced by increasing interaction between research projects and strengthening the link between research and the teaching provided in the Department.

Summary of the Physical Sciences

Strengths

- New versatile study environment on campus
- Teaching linked to high-quality research

- Significant outside financing
- Participation in national Graduate Schools
- Production of basic education for the Faculty's needs
- Extensive international study and research cooperation
- Curriculum that attends to society's needs
- Individual instruction provided by small disciplines
- Versatile teacher training and related "didactic" research

Challenges

- Coordination of joint instruction
- Implementation of new teaching methods
- Greater appreciation for educational work
- Development of teaching laboratories
- Cooperation between campuses
- Nation-wide responsibility for subject teacher education

Threats

- Insufficient appropriations
- Recruitment of sufficient and talented students
- Salary levels in the business world complicate the recruiting of teachers and researchers
- Visibility of small disciplines in a big department
- Short duration of LUMA support

Opportunities

- Cooperation with the school system
- Multidisciplinary cooperation in space and material research and biosciences
- Participation in big international projects enables pioneering research
- Utilisation of courses held in foreign languages when recruiting foreign students
- Versatile teacher training in Web-based teaching
- Direct entrance system for teacher training

Reference

Department of Physical Sciences **http://www.physics.helsinki.fi/**

SELF-EVALUATION REPORT OF CHEMISTRY

The self-evaluation report of Chemistry has been prepared by a working group consisting of Heikki Saarinen, Professor; Markku Räsänen, Professor; Kristiina Wähälä, Professor; Tuulia Hyötyläinen, Academy researcher; Susanna Pehkonen, postgraduate student; and Stewart Makkonen-Craig and Pertti Elo, students.

1. Overview

The Department of Chemistry aims to educate qualified and versatile professionals in the field of Chemistry, who are well prepared to work in a variety of Chemist's tasks both in Finland and abroad. Profound knowledge of one's own special field and other skills required of academic citizens form the foundation of a degree in Chemistry.

The research and teaching in the Department are closely linked to each other. Good teaching also requires research of high international quality. Thanks to its large number of specialisation sub-programmes, the Department of Chemistry is able to offer more versatile teaching than any other Finnish university. The Department's sub-programmes include Analytical, Inorganic, Physical and Organic Chemistry, Polymer Chemistry, Radiochemistry and Education for Chemistry teachers. The Swedish-speaking teaching laboratory has a strong profile in Computational Chemistry. The Department has national teaching responsibility in Radiochemistry and Polymer Chemistry.

The Department of Chemistry and the Kumpula campus offer students and teachers modern and appropriate work facilities. Modern teaching laboratories, the new campus library and IT services create excellent facilities for studies. The other departments on campus offer versatile study opportunities for many minor subjects that support Chemistry.

In the past years, an average of 60 MSc, 15 Licentiate and 15 Doctoral degrees have been completed annually. The number of degrees has clearly risen since the early 1990s. The Department has been able to achieve its degree goals quite well although certain fluctuation has also taken place. In 1999, the goal was clearly exceeded, while the number of graduates fell slightly short of the target in 2000. The long-term goal for the Department is an annual 74 MSc and 16 Doctoral degrees.

As a result of improved teaching and renewed degree requirements, the average time to complete the MSc degree has decreased from 7.5 to 5 years in the past ten years. The time spent on postgraduate degrees has also decreased considerably and graduates are now younger than ever. This is partly due to Graduate Schools, partly to increased external financing.

Most of the teaching in Chemistry takes place in small groups in laboratories. This requires significant resources in terms of personnel. The use of laboratories, research equipment for teaching purposes and teaching provided in small special fields generate a large outlay per student. The low budget funding of the past few years has made it particularly difficult to arrange basic education in laboratories.

2. Practical organisation of education

2.1 School cooperation and reform of student entrance system

The Department of Chemistry has found it difficult to attract motivated and talented students. To solve this problem, student entrance system has been renewed in many ways in the past years. In 2001, the universities of Helsinki, Turku, Jyväskylä and Oulu arranged a common entrance exam in Chemistry. The Department also cooperates with the Open University of the University of Helsinki. Students who

complete basic studies in Chemistry in the Open University with good grades may enter the University of Helsinki as a major subject student of Chemistry. The goal is to channel as many students as possible for whom a degree in Chemistry is only secondary into the courses of the Open University.

The Department has also worked on improving the recruitment of motivated students with good initial skills by increasing cooperation and introducing new forms of collaboration between the Department and upper secondary schools. Upper secondary school pupils may do part of the school-related laboratory exercises at the Department of Chemistry supervised by their own teacher and one of the Department's teachers. Upper secondary school pupils also have the opportunity to take courses in Chemistry or participate in more restricted courses that give a glimpse of what Chemistry and university studies are currently like.

The number of students aiming to become subject teachers has been insufficient in the past years. As a result, the entrance system of students interested in the profession has been reformed in many ways. Spring 1998 saw the introduction of a direct entrance system of subject teachers for Mathematics, Physics and Chemistry, in which students are selected for subject teacher education in a separate quota. In summer 2000, the Faculties of Science and Education introduced the option of completing the studies of subject teachers alongside regular employment as a form of distance teaching. Since 2000, subject teacher education has also arranged an entrance exam in the autumn term. The primary goal of this new entrance exam is to offer secondary school pupils who graduate in the autumn and show an interest towards the teaching profession the opportunity to initiate their university studies at the beginning of the spring term.

2.2 Improvement of study guidance

Dropouts in the degree programme of Chemistry have been relatively frequent, particularly at the early stages of studies. The Department has tried to help students adapt to the Department and studies of Chemistry by increasing the amount of study guidance and tutor activities. Since 2000, study guidance has been developed in subprojects related to the joint "Skill and support" project of the universities of Helsinki and Oulu. Related to the project, the Department has organised a course in orientating studies, focusing on the learning and understanding of Chemistry, study techniques, and various information search and IT skills. The course has received very positive feedback from students.

Since autumn 2001, the basic courses in Chemistry have employed students at the advanced stages of studies as course assistants. The goal is to even out the big differences in initial skills and knowledge of Chemistry of first-year students. Course assistants provide individual study guidance and teaching for students who face problems with their studies in Chemistry. A large number of students have attended the classes of course assistants and the feedback has been very positive. The Department has also had good experiences of arranging similar study circles in previous years. As this type of additional teaching clearly activates students, the Department intends to expand it.

2.3 Tutor activities and study guidance

Students are offered versatile guidance and counselling at the beginning of studies. Student tutors introduce the Department, studies, library, and IT and other support services. All new students also have a teacher tutor whose tasks include providing advice on goal-oriented studies and their planning. Most students have experienced tutor activities to be a useful way of getting familiar with the university community and work methods. However, the feedback also indicates that tutor activities – especially that of teachers – has remained distant to some students.

According to students, the study guidance offered at the early stages of studies is sufficient. At later stages, students have hoped for more individual supervision. Current plans include a lecture series for intermediate-level students, which would introduce the research activities of the different laboratories. The course would introduce students to the research that laboratories are involved in and facilitate the selection of specialisation areas.

Guidance during the preparation of the M. Sc. Thesis differs widely: while some laboratories arrange regular meetings, others provide supervision when students request it. Students at the end of their studies have hoped for more guidance, encouragement and feedback. Postgraduate students find the ratio between independent and supervised work to be well balanced.

2.4 Current status, development and evaluation of the educational skills of teaching staff

Only a small share of the teaching staff at the Department of Chemistry has completed degree courses in university pedagogy. The aim is to improve educational skills and expertise. The Department encourages teachers to participate in education provided by the University and also arranges its own courses to improve educational skills. The current offering includes, for example, a variety of courses in teaching methods and Web-based pedagogy. Recruitment of teachers also places more emphasis on teachers' educational skills by taking into consideration the feedback on teaching and the teaching merits included in the teachers' university portfolio.

2.5 Teaching methods, materials and tools

Most of the textbooks used in Chemistry courses are internationally known and widely used English books. They are supplemented with reference material distributed by lecturers, as needed. English textbooks introduce students to the special terminology of Chemistry during their first study year. Special assignments are also often carried out in an international research team, where sufficient skills in English are necessary. The oral presentation related to the special assignment may also be held in English.

The basic courses in Chemistry are usually taught in Finnish and Swedish. In 2001, four of the courses included in the degree requirements were taught in English. The Department also offered several lecture series, as well as summer and winter schools, which were held by visiting foreign researchers. Many special courses are also taught in English, and the exam material and questions can be obtained in English. Exam questions are provided in Swedish for students who so request, and exams can be answered in Swedish or English in addition to Finnish.

Many of the instructions for laboratory practicals are in Finnish, which makes understanding difficult for foreign students. Guidance in chemistry assignments is provided in English when needed.

Laboratory instruction is an essential part of the education of chemists, and it is provided both during and outside of the terms as intensive courses. Efficient laboratory exercises require a great deal of teaching and laboratory staff. Although the laboratory facilities are generally speaking sufficient and modern, the equipment used in basic education is partly outdated and needs to be renewed. Student feedback often centres on the old-fashioned equipment.

2.6 Use of teaching technology

The Department of Chemistry has been focusing more attention on the new opportunities offered by IT and data networks in addition to traditional teaching methods. Chemistry is an experimental science, in

which much of the teaching takes place in laboratories. However, part of the education can be provided in computer networks. The best results are achieved when virtual teaching is used to supplement traditional teaching.

The teaching technology working group established in the Department of Chemistry follows the development of IT use in teaching and ensures that new successful projects are communicated to other teaching personnel and introduced into teaching as efficiently as possible. The working group operates in connection with the Department's committee for development of teaching. IT and software are under continuous development, which emphasises the importance of arranging training and orientation events for teaching staff.

The Department has also increased the course-specific information provided on its homepages. This includes communication between teachers and students, as well as the provision of problem-solving exercises and other teaching material on the network. Some courses already offer problem-solving exercises and their model solutions on the course's homepage, and students can follow their exercise results on the Web page using their private password.

The Department has several ongoing projects focusing on the production of CD-ROM and Web-based teaching material. Completed projects include a work safety course offered on the Internet. Other projects in planning include various virtual laboratories for Chemistry linked to asymmetric synthesis and TLC chromatography, a CD-ROM produced as collateral material to a textbook on chromatography, as well as educational software for computational chemistry. Web-based courses offered by the Department have also been available through the Open University. The person responsible for the course is an employee at the Department of Chemistry.

Teaching material is increasingly created in file format and the Department has purchased several commercial books in CD format. This kind of material is likely to become more common in addition to traditional library material. Efficient use of electronic material at lectures requires suitable equipment to be available. The AV equipment in the lecture halls of the Department is currently being renewed.

A good example of the Department's teaching-related projects using IT is the workshop experiment, which introduces undergraduate students to the use of computational methods. This experiment allows students to use the visualisation options provided by computers to learn about the structure of atoms and molecules and the processes of chemical reactions. Student feedback indicated that students found the use of class teaching and visualisation software to be useful in the visualisation of three-dimensional potential surfaces. Assignments completed in Swedish-speaking courses have been published on the network. For example, the course in organic chemistry includes a Hyperchem assignment. The special course on *Relativistic Quantum Chemistry* is published on the Internet.

2.7 Interaction between teachers and students

New students are introduced to the Department's research teams at laboratory presentations (such as Open Doors events) or at informative meetings, and usually get to participate in actual research during special assignments or in postgraduate studies. Special assignments are usually related to the activities of research teams. The research methods used in some laboratories require a good command of certain fields of Chemistry before work on the assignment can be started.

2.8 National and international teaching cooperation

The Department of Chemistry cooperates with many other units at the University of Helsinki. It offers, for example, basic courses in Chemistry for students of Pharmacy, Biochemistry and Biology. In the

field of material sciences, the Departments of Chemistry and Physical Sciences are involved in close cooperation. Plans are to expand the current basic study module in Environmental physics and chemistry to include intermediate studies. The Department of Chemistry also arranges a Swedish-speaking course in Chemistry for first-year students of Biology. The Department will also be cooperating with the Department of Astronomy to provide a course in Astrochemistry in the academic year 2002-2003.

The Department of Chemistry offers a considerable amount of minor subject studies at the level of advanced studies for students of Biochemistry, Chemical technology and wood-processing technology, Food chemistry, Medicine and Pharmacy. For example, the laboratory of Radiochemistry is the only national unit of education that provides teaching in the basics of radiochemistry and radiation protection for students of Biosciences. Minor subject teaching requires a considerable amount of teaching resources, because the courses include both lectures and laboratory assignments or demonstrations.

The Department of Chemistry has signed Nordplus and Sokrates exchange programme agreements with various universities and has participated in the ERASMUS exchange programme since 1991. Student exchange is currently carried out with over twenty European universities within the framework of the SOKRATES/ERASMUS programme. The Department also participates in the European Chemistry Exchange Network, which includes dozens of European universities.

EU cooperation

The Department has actively participated in the development projects focusing on teaching launched by the EU commission, and is represented in the *Evaluation of Core Chemistry, Practical Skills, Teaching Methods and Assessment, Multimedia in Chemistry* work groups of the *European Chemistry Thematic Network* (*ECTN White Paper on Education and Training – Teaching and Learning - Towards the Learning Society COM*) programme. The Department's representatives have acted as chairperson in the *Objective 1: Encouraging the acquisition of new knowledge* programme, which designed and implemented a computer-based test for assessing the skills and knowledge in chemistry of secondary school and upper secondary school pupils and students at the intermediate stage of studies. According to test results, the knowledge of Chemistry of the Department's first-year students clearly exceeded the average international level.

The Department is currently represented in the *Synergy in Chemistry* work group of the *Tuning Educational Structures in Europe* project. In connection with the project, a questionnaire was sent to chemists who had graduated from the Department in the past four years, with the aim of surveying how the education provided by the Department corresponded to the requirements of working life. A corresponding questionnaire was sent to employers in the fields of chemistry and chemical technology. The final report will be published in summer 2002.

2.9 Graduate Schools in postgraduate studies

Postgraduate students can complete either the Licentiate or Doctoral degree. Postgraduate studies have a scope of 40 credits and consist of major and minor subject studies. The study modules can be chosen relatively flexibly according to students' own wishes and interests, which is appreciated by postgraduate students.

The Department houses several Graduate Schools, enabling students to concentrate full-time on research and studies. Joint Graduate Schools increase cooperation between universities. The resulting benefits include younger doctoral candidates and less time being spent on postgraduate studies. According to students, the main advantage of Graduate Schools is long-term funding and a wide range

of courses offered outside their own department. The Graduate School courses are often intensive courses (for example, summer and winter schools) taught by top names in the field. These lectures can also be attended by people outside the Graduate School.

2.10 Practical training and other connections with working life

Various orientating courses at the beginning of studies, such as *Chemical industry in Finland* and *Chemists in working life* introduce students to the kind of tasks that chemists work with in the industry and in research institutions. Some of the lecturers in advanced studies are employed by industry. During special assignments and in postgraduate studies, connections with working life are formed through joint projects. Special assignments can also be done at companies outside the Department. The courses and excursions arranged by the divisions of the Association of Finnish Chemical Societies provide students with the opportunity to get acquainted with industry. The Department of Chemistry offers a few annual traineeships for students. Summer traineeships in various research institutions provide students with work experience and are an advantage in future job recruitment. Practical training can be included in the degree as part of the basic or elective studies.

3. Evaluation and development of education

The Department aims to keep the degree requirements as well as the course content and study methods up to date. The Department's laboratories, individual teachers and students can make proposals to improve teaching. The development committee for studies, consisting of students and teachers of Chemistry, presents proposals to the Department's steering group, which decides on changes.

Teaching is also evaluated and developed on the basis of course feedback regularly collected from students. The annual "feedback day" offers students and teachers the opportunity to discuss development of teaching. The day is arranged by the Development committee of teaching.

3.1 Implemented reforms

The reforms made to the degree structure in the past years have focused on the intermediate studies of Chemistry, which have been made more optional. Students of intermediate courses in Chemistry may now also choose courses in Applied, Analytical, Polymer and Radiochemistry.

The shift in research focus has influenced the content of advanced studies, and the topic of special assignments, theses and licentiate dissertations. The subject teacher sub-programme now offers courses tailored to the needs of teacher training. The content of practical assignments for subject teacher students has been modified, and students now have their own groups of instruction and teacher tutors. Another experiment in the education for subject teachers includes courses with two teachers: one from the field of Education and another from Chemistry.

The Department has recently established two new fixed-term teaching and research posts: a professorship in Environmental chemistry and analysis and a lectureship in teacher training. The tasks of a university lecturer in teacher training includes the development of the structure and content of teacher training in Chemistry, didactic research in the discipline of Chemistry, communication with the University's Department of Teacher training, and the development and coordination of cooperation between the Department of Chemistry and upper secondary schools.

The Department of Chemistry is in the midst of a reform in the structure of offices, which is being carried out throughout the University. The reform will result in big changes in the tasks of teaching and research personnel. The biggest change concerns assistantships, which are now defined to be

postgraduate positions. A decrease in the teaching duties of assistants may make small group teaching more difficult.

3.2 Student assessment of the level and characteristics of teaching

According to collected feedback, students are mainly satisfied with the teaching provided in the Department of Chemistry. Interesting topics, small group teaching, and inspiring teachers were felt to be motivating. The workload in some intermediate-level practical assignments was considered too big in view of the credits awarded, and students hoped for more guidance in the preparation of work reports as well as more modern equipment and methods for practical assignments. Some assignments in basic studies employ too small a number of assistants compared to the number of students, and certain advanced-level courses are not offered frequently enough, thus slowing down studies. The limited number of courses may lead to students not having enough options to choose from, which forces them to take any advanced course that is taught if they want to graduate in a reasonable amount of time.

3.3 Foreign students

In the academic year 2000-2001, 20 foreign students, approximately half of whom were major subject students, participated in the teaching offered by the Department. Seven of the major subject students were postgraduates. Around half of the foreign students attended classes in the Finnish language. Some students commented on the lack of courses or found that the Finnish taught in the courses was not the kind needed in the studies of Chemistry.

The main source of information for foreign undergraduate students was the Faculty's teaching programme; the amount of individual study guidance was small. Foreign students felt they received insufficient tutoring. Courses were completed by exams based on English textbooks and material; foreigners rarely attended lectures. Exam questions were provided in English, if requested, and answers could be written in English. According to foreign students, laboratory instruction was of high quality, but instructions on work safety should have been provided in English. Completion of postgraduate degrees was promoted by good opportunities for experimental work, while obligatory studies were considered to slow down studies. Postgraduate students felt a part of the staff of the Department.

3.4 Exams and other methods of evaluating learning

Most courses are traditionally completed with mid-term or final exams. Especially in the basic courses of Chemistry, a written exam is almost the only practicable solution in view of the large number of students. Many courses also include exercises that students are expected to solve and hand back for grading. This is a way for students to get individual feedback on their work. Advanced-level courses in particular have offered a variety of evaluation methods, including oral exams, essays or poster presentations.

3.5 Graduation, employment and connections with working life

The employment situation of graduates from the Department of Chemistry is monitored along with the professional organisations in the field. Connections with working life have also been maintained by inviting representatives of the chemical industry as visiting lecturers. The Department has direct connections with the Chemical Industry Federation of Finland and Finnish bioindustries, an association representing employers in the field of chemistry, whose managing director is one of the Department's steering group members. This channel provides the Department with immediate information about estimates concerning the education and employment of chemists. According to the Federation, Finland will experience a lack of skilled chemists in the near future.

The employment survey of university students published by the Helsinki University Career Services in spring 2001 focuses on students who graduated from the University in 1997. Three years from graduation, 82% of graduates had achieved a postgraduate position or job corresponding to their education. The unemployment rate among those studied was 3%.

3.6 Prizes and rewards

In 1999, the Open University awarded two of the University's departments for their merits during its 20th anniversary festivities. One of these was the Department of Chemistry, which was awarded for its versatile and productive development work carried out in the Open University.

The student organisations in Chemistry (HYK and Spektrum) annually choose the best teacher in the Department. The Best teacher of the Year prize has been awarded in connection with the Feedback day since 1996.

The Association of Finnish Chemical Societies awards a special prize for talented young researchers in the field of chemistry. The Komppa dissertation award is awarded annually to the best dissertation in the field of Chemistry or Applied chemistry published in Finland. During the past ten years, six awards for young researchers and four Komppa dissertation awards have been granted to researchers who have graduated from the Department of Chemistry at the University of Helsinki. Alfthanska Priset is an award given to distinguished young researchers of Chemistry or Chemical technology. In 1998 and 2000, the recipient of the award came from the Department of Chemistry at the University of Helsinki. The Faculty of Science grants the Hjelt award to the best thesis in Organic chemistry.

4. Future prospects and development plans for education

The degree programme in Chemistry aims to educate qualified and versatile experts in the field of chemistry who are well equipped to work in trade and industry, research institutions, and universities. The Department aims to maintain the degree requirements, and the content of teaching and degrees at a high international level. This requires continuous monitoring and reassessment of degree requirements, as well as teaching methods, practices and content.

The development and coordination of teaching require close cooperation between the Department's teachers and students. This creates a positive atmosphere for learning and teaching. The general goal is to move from teacher-centred learning towards student-centred learning. The Department aims to create different forms of tutoring to activate students.

The goal of the changes to and cooperation in the national selection method is to recruit motivated and talented students of Chemistry. The influence of changes made to student selection criteria in Chemistry is continuously monitored. Cooperation between the Department of Chemistry and upper secondary schools will be continued and further developed. The direct selection of students for subject teacher education will also be continued and the number of teacher training courses will be increased.

The utilisation of new teaching technology will be emphasised in the future development of teaching and degrees. More attention will be paid to the opportunities offered by information and communication technology in addition to traditional teaching methods. The Department's own Teaching technology group monitors the development of information technology in teaching and aims to ensure that successful projects are introduced to the teaching staff and put to efficient use. Increasing the number of educational events for teachers plays an important part in the utilisation of the benefits provided by new technology.

Special attention will be paid to the creation and maintenance of course-specific Web pages. The Department is involved in several projects focusing on the production of CD-ROM and Web-based teaching material. The practical assignments in Chemistry will also offer students more opportunities to use information technology. The technological equipment in the Department's lecture halls will be kept up to date.

Virtual university activities are actively developed both at the University of Helsinki and within the national virtual university. In the undergraduate education of Chemistry, national projects are useful especially in the case of higher-level and special courses. They enable the wide-scale distribution of material produced in different universities and lead to more versatile teaching.

SWOT analysis

STRENGTHS
* Wide-scale teaching opportunities in all of the core fields of Chemistry
* Modern laboratories and teaching and research facilities
* Good IT and library services
* Active cooperation with several national and international research groups
* Good connection with the Chemical industry and research institutions

WEAKNESSES
* The poor status of Chemistry in the Finnish school system
* Difficulties in the recruitment of new students
* Division into laboratories restricts internal cooperation in the Department
* Mass lectures in the basic Chemistry courses
* The University's new staff structure is poorly suited to laboratory teaching
* Small number of postdoctoral and young researchers
* Partly outdated laboratory equipment

THREATS
* Insufficient budget funding
* The Finnish chemical industry being transferred to foreign ownership
* Industrial research laboratories moving abroad

OPPORTUNITIES
* Cooperation with other departments provided by the new campus structure
* More efficient cooperation between the Department's laboratories and better coordination of teaching
* Establishment of the new professorship in environmental chemistry and analysis
* Establishment of the new university lectureship in teacher training
* More efficient teacher training
* Utilisation of new teaching methods

Table 2

Teaching staff in the Department of Chemistry

The Laboratories of Chemistry at the University of Helsinki in 2000

Laboratory	**Analytical Chemistry**	**Inorganic Chemistry**	**Physical Chemistry**	**Organic Chemistry**	**Polymer Chemistry**	**Radio-chemistry**
Head of the laboratory	Marja-Liisa Riekkola (1987-)	Markku Leskelä (1990-)	Lauri Halonen (1992-)	Tapio Hase (1984-)	Heikki Tenhu (2001-	Jukka Lehto (open)
Professors*	1	3	2	3	2	1
Lectures	-	2	1	-	-	-
Teaching ass.	4	10	8	10	3	2
Other teachers	-	4	1	-	-	-
Lab. managers /aman.	2	3	2	2	1	2
Other res. pers.	-	-	-	-	-	-
Ext. lectures	13	32	12	31	23	24
Total	12	3	4	11	9	4
	32	57	30	57	38	33

SELF-EVALUATION REPORT OF COMPUTER SCIENCE

Working group: Marja Huovinen, Department coordinator, fee-paid teacher; Päivi Kuuppelomäki (compiler of report), MSc, Assistant; Heikki Lokki, Licentiate, Lecturer; Greger Lindén, PhD, University lecturer; Jukka Paakki, PhD, Professor; Antti-Pekka Tuovinen, MSc, postgraduate student

1. Overview

In accordance with the strategy (2001-2003) of the Department of Computer Science, the Department offers a modern and versatile degree programme that emphasises the conceptual basis of Computer Science and produces experts for the development, production and research tasks of industries and public administration. Teaching is based on the generally accepted core fields of Computer science but also adapts to new skills requirements in the field. The curriculum is drafted in accordance with international standards following the so-called CR classification of computer science maintained by ACM (Association for Computing Machinery).

The professional goal of education is to provide all students with the basic skills to work in the core fields of the discipline: students should be familiar with the basic terminology of the field and should be able to creatively apply desing, implementation and analysis methods. The academic profile is manifested in the tendency towards universal solutions, whose validity can be justified, whose performance and limits are known, and whose adaptability enables their application in new environments. The Department's degree programme focuses on the core areas of Computer science, but the flexible choice of minor subjects provides students with the opportunity to specialise in a number of fields in which the methods of Computer science can be applied.

The fast development of Computer science technology and the expanding social significance of it generate new educational needs, including teacher training, minor subject education, further training in the field, as well as postgraduate education focusing on the research and development needs of industry. Bringing the skills profile of professionals in working life up to date is a special goal of the upgrading programme of education.

The structure of the degree programme in Computer science has been designed to offer the skills required for typical career choices of professionals and researchers of Computer science. The degree programme includes the following sub-programmes, which also indicate the focus of the Department's research:

* Computer Science sub-programme
  - Algorithms, specialisation area
  - Intelligent systems, specialisation area
  - Software engineering, specialisation area
  - Distributed systems and data communication, specialisation area
  - Information systems, specialisation area
* Applied Computer Science sub-programme
* Teacher of Computer Science sub-programme
* Computer Mathematician sub-programme

In 1996-2000, an annual average of 56 MSc, 4 Licentiate and 3 PhD degrees were completed in Computer Science. The number of credits produced by the Department is among the biggest in the University of Helsinki (20,554 credits in 2000). The Department aims to increase the number of degrees by supporting the completion of theses and enhancing the guidance provided to postgraduate students.

2. Practical organisation of education

2.1 Teaching and study culture

The Department sends first-year students a welcome letter, which also includes the Department's own dataBitti magazine aimed at upper secondary school pupils and new students. The Department's homepages also include sections for candidates for the matriculation exam, and orientation pages for new students. Teachers present the Department and the curriculum to new students at the beginning of the academic year. The Department cooperates with twelve upper secondary schools in the Helsinki area, from which 56 pupils have been selected to complete basic courses in Computer Science in the period 2000-2001.

The Department offers teaching in various forms. Lecture courses last either six weeks or one full term with 2-4 hours of lectures and one 2-hour problem-solving class a week. In some courses, students also write essays, computer programs, and learning diaries. Newsgroups are used for course-related discussions in some courses. Laboratory work helps deepen knowledge and put the skills learned at lectures into practice by carrying out constructive programming and design assignments. Software engineering projects aim at familiarising students with the methods, tools and documentation methods of software production, as well as project work in groups. Another goal is to introduce students to experimental and constructive study and development work in the IT field. Advanced studies include a minimum of two seminars. They are based on introductions and discussions, so that students are required to prepare at least one introduction and to actively participate in other work. Writing and thesis work is practised in the course on scientific writing. All laboratory assignments also include documentation. Students' skills in scientific writing are assessed in their thesis. Students also complete a maturity test either on their thesis in the scientific writing course or on their Master's thesis. As the number of credits translates directly into the number of lectures and exercises, the workload of courses is in good proportion with the requirements.

The Department provides a sub-programme with its own degree requirements for teachers. The sub-programme has its own responsible Professor, who is responsible for the education in the sub-programme.

The criteria for course completion are defined separately for each course. Grades are usually based on exams, assignments, essays and problem-solving exercises. Courses typically include one or two exams depending on the credits awarded. Some lecture courses also offer the opportunity to take part in a retake exam, which has the same requirements as the exam arranged in connection with the course. Separate exams are independent of lecture courses and are based on material defined in the course description. Results, exams and their solutions are published on the Department's bulletin board and on the internal Web pages. Students can discuss their exam grades during the office hours of teachers.

Tutoring is arranged both by students and teachers. Student tutoring is arranged for first-year students, who are divided into groups tutored by older students. Teacher tutoring aims to increase cooperation between students and the Department, raise course grades, and strengthen students' commitment to their studies. Students are divided into teacher tutor groups at the beginning of the second year of studies. Tutoring, worth one credit, lasts for two academic years and is an obligatory part of the degree requirements of major subject students. Tutoring groups provide study guidance, prepare individual study plans for students and monitor the implementation of the plans. The group meets about once a month for seminars or group work. Each student also meets in private with her or his tutor every term.

Study counselling is supported by the Faculty of Science's teaching programme, which is published once a year and includes information on the Department, degree requirements and a model schedule based on the goal of graduating in five years. The guide also includes information on the courses offered, short course descriptions and a presentation of sub-programmes and specialisation areas,

postgraduate studies and Graduate Schools. The Department's Web pages are the most important source of information for study counselling. The core part of the site consists of more than 50,000 pages and it is continuously updated. The pages include the teaching programme, course descriptions, course information, information on exercise groups, exam schedules, lecture notes of courses, and instructions for thesis work. The site also provides information on the sub-programmes and specialisation areas, the special research training programme, the Faculty, research conducted in the Department, the upgrading education programme, library, computers, international student exchange and the acceptance of studies done elsewhere. The Department also has English homepages for foreign students. Course descriptions and schedules can also be found on the Department's bulletin board. The Department has five student advisers (for the different levels of studies and for foreign students). All teachers have weekly office hours during terms. A "service desk" is located near the computer labs. Students working on laboratory assignments can go there for advice. First-year courses also include guidance for assignments.

In several courses, course assistants and the person responsible for the course meet regularly to discuss teaching methods and their improvement. The teachers of each sub-programme and specialisation area hold a planning and monitoring meeting each term at which they review the past term and plan the next one, discuss the development of teaching, new courses to be included in teaching and courses that should be dropped.

In the academic year 2000-2001, the Department accommodated ten exchange students. In addition, several foreign students are working on a major or minor in Computer Science at the Department. Exchange students are usually among the best in their own departments and have done well in courses. Some foreign students, however, have had trouble with English. Foreign students usually take courses held in English - especially in their first year of studies.

2.2 Teaching and learning environment

Teaching material includes textbooks, overheads, and lecture notes prepared by the Department's teachers. In 1999, teachers prepared seven lecture notes and in 2000, eight. The Department's teachers have been involved in the compilation of several Finnish and English textbooks. For several years, course information has been published on the courses' own Web pages. The lecture notes and exercises of many courses are also published on the Internet, and teachers communicate topical issues on the Web pages of the various courses.

Swedish instruction is offered mainly in the course "Introduktion till datorn som arbetsredskap" (Introduction to the Use of Computers). The course in scientific writing also provides guidance in Swedish, if needed. The documents in practical assignments, theses, and other documents can also be written in Swedish. English instruction is offered in the course "Introduction to the Use of Computers" as well as in some more advanced courses and seminars. Many courses offer English-speaking exercise groups as needed, and while the lectures are held in Finnish, there is usually litterature in English, or the lecture slides are in English, which makes it easier for foreign students to participate in the courses. Exam questions are also provided in Swedish and English, in addition to Finnish, if requested.

The Department has three teaching and study periods: autumn, spring and summer. In the autumn and spring terms, courses of 2 credits have been devided into two periods. Most teaching takes place in the middle of the week as these times are favoured by students. Evening classes are arranged as much as possible. Exercise groups are scheduled around lectures and sometimes several parallel groups are held at the most popular times. Evening and weekend courses are arranged for students participating in the upgrading programme. Lectures during the first two years of studies are scheduled so that they do not overlap with the recommended courses in Mathematics. Laboratory work and software engineering

projects can be completed in the summer term. The Open University enables students to complete first-year courses in the summer, in addition to which the Department organises separate course exams.

Teaching takes place in the auditorium seating 250 people and located in the Department's facilities, in three lecture halls seating 60 people, 8 exercise rooms and 7 group work rooms. The Department also has 11 computer labs of its own where students can use computers around the clock every day of the year. The Department is committed to offering a wide range of highly developed, top-quality Linux-based computer equipment for its staff and students. The equipment is used by some 3,100 people.

Students sign up for courses and special exams using a Web-based enrolment system, which makes it possible to monitor how exercise groups and laboratory courses are filling up and to increase the course offering if needed. A course accounting system, which is used to register nearly all of the Department's teaching, has also been created as an aid for teachers. The data in the system can be automatically transferred to the University's course register.

The Library of the Department of Computer Science and the IT Department, administratively connected to the Kumpula Science Library, is located in the same facilities as the Department and includes Finland's largest collection (45,000 volumes) of Computer Science books, reports, conference publications and magazines.

2.3 Progress of studies

The main influence on the progress of studies seems to be the extent of students' employment while studying. According to the responses that students provided in a teacher tutoring survey, one of the main reasons for students working alongside their studies is the high price level around Helsinki, particularly the housing costs, which the study grant does not cover. Some 55% of second-year students are already employed, around 15% of whom work full time. The number of students with employment increases in later study years.

The Department aims to arrange small group work in the evenings to make it easier for working students to participate in teaching. In addition to the comprehensive second- and third-year teacher tutoring, students with less than 10 credits after the first year have been separately contacted to offer them the opportunity to take part in tutoring to speed up studies. Most of these students have already given up their studies in Computer Science. The Department also contacts students with over 100 credits to speed up their Master's thesis work.

Only approximately half of the students registered in the Department start their second year of studies and only half of these students (25-30% of students admitted) complete their MSc degree. These figures vary somewhat depending on the labour market situation. The Department registers some 20,000 annual credits, which is almost as much as the total number of credits achieved by the Faculty of Theology, and the figure is growing. Approximately half of the total number of credits is accounted for by students that graduate, some 30% by minor subject students and around 20% by dropouts.

In general, the Department considers both dropping out and delayed studies to be a problem. Teacher tutoring and other direct contacts aim to help students to progress in their studies, but the Department has very restricted possibilities to fight against labour market trends and fluctuations in the general price level. On the other hand, the fact that students are widely employed in the IT business sector may also reflect the high quality and up-to-date content of teaching.

2.4 Values, quality and atmosphere of the teaching, learning and research community

The Department suffers from an insufficient number of teaching staff and it is difficult to find enough qualified teachers in proportion to the Department's large student numbers. Two annual training events are arranged for staff, one of which is for new teachers and the other for all teachers. Teachers are also encouraged to participate in the staff training organised by the University.

An application procedure is applied to filling permanent posts and staff structure is developed to correspond to future challenges. Fee-paid teachers are mostly recruited among the Department's own students and selection emphasises study success and performance skills. The intention is to recruit the best part-timers as full-time employees. The goal is for all holders of teaching and research posts to take part in both teaching and research duties. In certain tasks with emphasis on teaching, research can be replaced with the development of the content and methods of teaching; correspondingly, certain tasks emphasising administration may have a different work profile.

The Department's permanent teachers are committed to their work, which is indicated by a relatively stable teaching programme. Committed teachers form the basis for comprehensive and well established teaching at the intermediate level, and sub-programmes and specialisation areas with their own courses and seminars are built on this foundation. The core courses of the teaching programme are arranged every academic year or term.

As an award for the Department's atmosphere (including fields other than teaching), the University Senate granted the Department an incentive prize for high-quality working culture. The prize was awarded by a council that visited the Department and interviewed a large number of the Department's staff and students.

Possible burnout is a disadvantage of the strong commitment of teachers, especially because of the exceptionally heavy external pressure for education in the discipline. To prevent burnouts, the Department uses the opportunities provided by the flexible person-hour system (1600 hours per year) so that teachers can now and then mainly focus on research. Full-term paid research leaves have also been arranged.

Despite working hour arrangements the Department's teaching load is close to exceeding sensible limits. The Department's strategy states that the growth in teaching loads will be stopped by the latest in 2002 at a level which is at the most 15% higher than that of 2001. To enable this, the number of admissions of major subject students will be decreased as of 2001 and minor subject studies will be restricted and kept at a level that teaching resources can cope with. The growth limit of the upgrading programme will be estimated on the basis of experiences in the academic years 1999-2000 and 2000-2001.

Students feel that they are given attention in the Department's steering group, and students are represented in many internal development groups. Staff and students are relatively separate communities, but active students find it quite easy to integrate into the Department. The student organisation TKO-äly as well as a common student room enhance the satisfaction of students. Teacher tutoring and the personal meetings it enables also contribute to students' commitment to the Department.

General values in the University strategy include the pursuit of knowledge and truth, a critical approach, creativity (research), autonomy, expertise, social influence, research ethics, education (multi- and cross-disciplinarity), internationalism, equality, democracy and sustainable growth. These general values are implemented in the Department's teaching and through established academic practices, as well as by

active participation in strategically selected research areas of the international scientific community. Students also receive multi- and cross-disciplinary education through their minor subjects.

In addition to the University's general values, the Faculty's strategy emphasises skills in Natural sciences, a high international level of teaching and research, the role that teaching and research activities play in increasing the nation's well-being, as well as the provision of education required on future labour markets. To pursue these goals, the Department has defined Mathematics as one of the minor subjects of most of its major subject students. Most of the research carried out in the Department is funded by external sources, most of which are industrial enterprises. Consequently, research results end up in more general and industrial use. A good indication of the relevance of the Department's education on labour markets is the fact that nearly all students towards the end of their studies are employed and graduates do not have problems finding jobs. As an indication of the quality of its research, the Department was granted the best possible grade 7/7 in the evaluation of all research at the University of Helsinki in 1999.

2.5 Connection of basic education with scientific research

The course "Introduction to Computer Science" offers an overview of the different subfields of Computer Science, presented by experts in different fields. The presentations focus on areas in which the Department conducts research. Full-time members of research groups also provide regular teaching, especially in their own special field.

After successful studies lasting 2-4 years, students may apply for a special research training programme that aims at postgraduate studies. The students of this option mainly take the same courses as other students, but it is recommended that they take more courses in Mathematics, and their exercises and assignments are more challenging and innovative. Students in the research training programme usually carry out their postgraduate studies in one of the Graduate Schools (HeCSE or ComBi). Special courses are organised according to the Department's research focus.

Many of the topics of software engineering projects have originated in the Department's research teams. The thesis in the scientific writing course and especially the Master's thesis can deal with a topic of some of the research groups. In this case, the student is often employed as a member of the team. The Department provides thesis grants to its students to enable full concentration on the Master's thesis. The topic of these students' thesis is often related to research.

2.6 The Faculty's internal, national and international cooperation in teaching and study

The specialisation option of Applied Computer Science enables a degree with more comprehensive minor subjects than usual. The Department is involved in the national network for teaching of language technology, which enables comprehensive and multi-disciplinary studies in language technology in various universities. The specialisation option of Computer Mathematicians resembles the option of Applied Computer Science with an extended minor subject in Mathematics. Teaching is carried out in cooperation with the Department of Mathematics.

The Department of Computer Science cooperates with that of Education in the IQFORM project, which aims to develop the quality assessment and support system of learning. The project is one of the Finnish virtual university's development projects related to study guidance and support and is funded by the Ministry of Education.

The Department of Computer Science, the Helsinki University of Technology and the Helsinki School of Economics offer their major subject students a joint minor in Software business. The University of

Helsinki has also entered into the Flexible Study Right Scheme, JOO, with all the other universities in the Helsinki region, as well as the universities of Tampere and Jyväskylä. The scheme enables students to apply for the right to attend courses (which their own university does not offer) at other institutions.

The Department has cooperated for several years with the University of Petrozavodsk. The goal is to cooperate to develop the academic education of the region's IT sector, which we expect to be of future use also to Finnish industry. Cooperation with other parties has also enabled the organisation of an annual research seminar in Petrozavodsk, which 3-6 of the Department's researchers have taken part in. Correspondingly, a few (postgraduate) students from Petrozavodsk have also spent some time at the Department of Computer Science complementing their studies.

The Department participates in the EU's Sokrates/Erasmus student exchange programme, as well as the Nordic Nordplus programme. In the academic year 2000-2001, nine students from our Department studied abroad and can apply for their foreign studies to be accepted as part of their degree. The Department has a contact person for international activities and a foreign student adviser.

2.7 Practical organisation of minor subject teaching and studies

As many departments at the University restrict the number of minor subject students, all of our students have not been able to study the minor subject they would have wanted to. The Department of Computer Science offers a considerable amount of minor subject teaching. In 2000, students outside the Faculty of Science completed a total of 1,652 credits in Computer Science, which corresponds to approximately one-fourth of all teaching offered by the Faculty to students of other faculties.

2.8 Practical training and other connections with working life

During 2000-2004, the Department holds an industrial professorship, half of which is financed by the Ministry of Education and the other half by a company (currently by Nokia Research Centre). The industrial professor works to provide a bridge between the company and the University with the aim to create bilateral information exchange on topical issues and IT-related problems in research and development. Another goal is to launch joint research projects and recruit company employees to hold exercises and lecture courses at the Department.

In the academic year 2000-2001, the Department had 25 outside lecturers (lecture courses, seminars, and the "Information Technology - Now!" lecture series on topical issues in information technology). Many software engineering projects have been done outside the Department. In autumn 2001, most of the projects were running outside the Department. More than 40 percent of Master's theses in 2000 were produced for a company (by a student working there), half of these for Nokia. The Department has twice arranged a colloquium series on information technology, during which experts have lectured on issues related to future information technology and the information society. Company representatives have accounted for roughly half of the lecturers.

Students can apply for traineeship involving IT in public administration. IT-related work experience can be awarded with 2-6 credits.

2.9 Postgraduate studies

Postgraduate studies are best carried out in one of the Department's research groups so that students can enjoy the support provided by the group. The topic of postgraduate studies is settled on the basis of discussions with the Department's professors and other researchers. Studies are formally initiated by enrolling with the professor of the discipline in question, with whom the student determines the general

topic area of the dissertation (the final topic will be settled as the work progresses), as well as the specialisation area and minor subject studies. This is registered as the postgraduate study plan. A personal supervisor is also appointed for each student. The number of postgraduates in 2000 amounted to 74, 33 of whom studied at the HeCSE Graduate School and 6 at the ComBi Graduate School. In the spring term, 10 HeCSE students received funding (for a total of 70 months) from the Ministry of Education, and in the autumn, this number rose to 12 (for a total of 59 months).

HeCSE is a joint Graduate School of the University of Helsinki and the Helsinki University of Technology, which aims to make postgraduate studies more efficient. Students can apply to the School every year, and the Board of HeCSE selects the students on the basis of their qualifications and references. The School aims to provide students with the opportunity for full-time university studies in existing research groups rather than being a degree programme with its own courses, supervisors and teachers. The School can arrange funding for some of the students: fixed-term funding by the Ministry of Education is channelled through the School to postgraduate students to facilitate their studies. The Head of the School aims to interview the students of the School every year. No other feedback system is in use. The number of graduated doctors has clearly increased while the School has been in operation.

ComBi is a (multi-disciplinary) Graduate School focusing on computational biology, bioinformatics, and biometrics offered jointly by the Department of Computer Science at the University of Helsinki, the University of Turku and the University of Tampere. The School combines the methods of Computer Science, Mathematics, and Statistics, with Biology as the common area of application.

Graduate Schools are promoted as the main path towards a postgraduate degree. Postgraduate studies can, of course, also be carried out in the traditional way (by participating in the Department's teaching and research activities, or connected to professional work), as long as the student can find a supervisor for his or her work. The postgraduate study plan can, to a large extent, be negotiated between the supervisor and student. The most important point for the Department is that the supervisor is academically qualified.

A general problem in postgraduate studies seems to be the lack of postdoctoral researchers who could support postgraduate students and with whom postgraduates could discuss their studies. Official supervisors are usually very busy. Many research groups are also too small to allow the creation of a "critical mass". To increase the number of postdoctoral positions, the Department has established posts for doctoral assistants.

Three licentiate dissertations and five doctoral dissertations were completed in 2000.

3. Evaluation and development of education

Students have been encouraged to provide course feedback twice each term at course-end. The feedback system has been renewed for the following academic year to enable students to provide feedback at any time. Feedback is given anonymously using a Web form. Teachers can view the feedback they receive during the course and all feedback is summarised after the course ends. Students feel that the feedback system works well and value the opportunity to provide feedback. To further encourage students to provide feedback, many courses have made feedback part of the course exercises that students get extra points for.

The Department collects student feedback on a separate form from students participating in teacher tutoring. The person responsible for teacher tutoring summarises the collected information. Teachers also get feedback directly from students in the course on scientific writing and in software engineering projects, as well as from those writing their thesis.

The University Career Services has monitored the employment of recently graduated students ever since 1996. The survey has also interviewed recently graduated students on their opinions about the level and development of education. The survey in 2000 showed that the theoretical and informational content of education was felt to offer a good starting point for the future. Practical assignments and other courses were the best part of teaching. The interviewees hoped for more thesis guidance, as well as practical exercises and assignments. All interviewees that had graduated from the Department of Computer Science and had applied for work had been employed at the time of graduation.

The Department has participated in the national assessment of degree programmes related to information sciences, carried out in 1998-2000. The evaluation included self-evaluation and an assessment by external experts. The evaluation recommended that the Department should simplify its management practices. Assessors felt that the size of student groups in some basic courses was alarmingly large. The Department was also recommended to increase cooperation with businesses and emphasise activities related to internationalisation. The evaluation panel also urged the Department to develop feedback collection. The technical implementation of the feedback system has now been reformed to enable teachers to acquaint themselves with feedback as soon as it has been given and to follow feedback while the course is in progress. Management practices have been developed by appointing professors in charge for each of the Department's sub-programmes and specialisation areas.

The Department's research was evaluated in a 1999 survey focusing on the entire University. The Department received the best possible grade, 7/7. Based on the comments provided in the evaluation, research in software engineering has now been more explicitly focused.

Many of the Department's teachers have been rewarded for their teaching merits. Teemu Kerola was granted the "Award for the Best Teacher Teaching through a Foreign Language at University of Helsinki 2000". Harri Laine received the teaching technology prize awarded by the University of Helsinki in 2000. The 1998 teaching technology prize was awarded to Arto Wikla for particularly valuable work in applying teaching technology in the Introduction to Programming course. In 1997, the same prize was given to Jaakko Kurhila.

The recognition of the Department's teachers is also indicated by their membership in the following working groups: The University of Helsinki Academic Affairs Department, the Teaching development committee of the Faculty of Science, The University of Helsinki virtual university working group, the Information strategic working group of the Ministry of Education focusing on research in learning environments, and the Professional education working group of the Finnish Information Processing Association.

The degree requirements were renewed in 1998-1999 and 1999-2000. Two new specialisation areas were added to the sub-programme of Computer Science and the General computing specialisation area was divided into two specialisation areas: Algorithms and Intelligent systems. The specialisation area in Software was also divided into two specialisation areas, one in Software engineering and another in Distributed systems and data communications. Many courses were split into smaller units (usually two). The credit requirements in Mathematics as a minor subject of Computer Science were decreased to 15 from the previous 26. Other reforms included teacher tutoring initiated in 1997.

Important new fields that the Department aims to invest in include the sub-programme of Computer Mathematician, the minor subject module of Software Business, and Language Technology.

A new computer lab was created for the teaching of Data Communications, and its teaching uses are currently being developed. The Department also has a robot used in research, which has also been used to some extent in teaching, for example, in software engineering groups.

4. Future prospects and development plans for education

A. Content of teaching

Forty-six credits of the studies in Computer Science are common to all major subject students. The content of these studies is relatively stable and constitutes the conceptual and informational basis for later studies, which have a minimum scope of 30-45 credits depending on the sub-programme. After the common part, the content of studies is planned with representatives of the Department's research areas so as to strengthen the Department's current interests. The Department makes efficient use of the rearrangement options of posts, enabled by the University's current administration model, by allocating resources to new special disciplines in the fields of Computer Science and Information Technology.

B. Teaching methods

The Department of Computer Science has used data networks as a support for teaching and learning for several years. The first Web-based support materials for courses were prepared in 1996 and 1997. The University lecturer post in network pedagogy was established in 2000 and has enabled the Department to focus more comprehensively and closely on the development of network teaching. The most important activities include the University's virtual university working group, and the TueLip project (Top University e-Learning International program), which is a joint project between the Computer Science departments of several European Technology Universities and the Department of Computer Science at the University of Helsinki. The aim of the project is to incorporate network courses into basic education. Courses are designed in cooperation with the different parties, with three of the Department's teachers closely involved in the project.

The Internet and Web are regularly used in every course. All courses have a homepage and some courses use discussion groups as active forums for interaction between students as well as students and teachers.

The academic year 2001-2002 will witness the Department's first true network courses (all the lectures of which can be replaced with network activities) and the use of network-based learning environments as platforms for group work. The first authentic network course (Introduction to Databases) has been designed in cooperation with the Open University of the University of Helsinki.

Various forms of teaching are used in the Department's optional and advanced studies. In many courses, teaching is arranged to activate students: assignments prepared in groups, intensive seminars and poster seminars, learning diaries.

The Department houses a Development team for teaching, which creates new forms of teaching and helps teachers to implement them. The goal is to study new problem-based learning methods in big courses with more than one hundred students and to use network teaching more extensively. Another activating form of teaching that is currently being discussed concerns study circle activities linked to courses. The Development team also manages the internal prize awarded for good teachers, which was granted for the first time in autumn 2001 (2 prizes).

Plans include combining the minor subject studies in Mathematics, Applied Mathematics, Computer Science and Statistics into a single minor study module of the Methodical Sciences. The goal is to make minor studies in the Methodical Sciences particularly useful for the institutions that apply them. The content of teaching is agreed upon with representatives of the applying disciplines. The starting point could be a "study receptacle for the methodical sciences", which would include at least 35 credits worth of studies in each science. Students could use this basket to select a minor recognised in the student's discipline.

Based on this self-evaluation, the Department has planned the following activities to develop teaching: industrial committee for the development of teaching, development of feedback systems, increased teaching cooperation (HUT, HSE, companies), training customised to company needs, development of Graduate Schools (research methodology, courses supporting the dissertation process, development of feedback systems), new activating forms of teaching (network teaching, problem-based learning), assignment guidance/study circles (particularly the upgrading programme), postdoctoral positions for the supervision of postgraduate studies (Graduate Schools), support for the linking of studies and working life, more flexible postgraduate study options, guide for postgraduate students (including dissertation criteria).

We would like to particularly emphasise the following development projects:
* Individual support activities for teaching (tutoring, study circles etc.)
* Minor subject module in the Methodical Sciences
* Problem-based learning

5. Summary

Strengths
* Stable degree structure and teaching programme (specialised education based on comprehensive basic education)
* Committed attitude to teaching
* Teacher tutoring, particularly for second- and third-year students
* Practical skills provided by students' working in IT companies
* Cooperation with companies, particularly concerning Master's thesis work
* Modern and comprehensive IT infrastructure
* Top-quality research in a number of fields

Weaknesses
* Excessive teacher workload, lack of teachers, large share of inexperienced (fee-paid) teachers
* Hindrances to studies caused by other work, dropouts
* Inefficiently launched studies in the first year
* Small number of postgraduate degrees
* The Department's weak image among young people, especially compared to Technical Universities
* Locating talent for research at the early phases of studies

Threats
* The attractiveness of industry and other universities: undergraduates, postgraduates, teachers, as well as researchers leave
* Small share of basic funding and uncertainty of project funding, which make long-term planning difficult
* The discipline's weakened image due to general threats in the field of IT
* Excessive student numbers compared to the number of teachers
* Burn-out suffered by staff

Opportunities
* New, activating forms of teaching (problem-based learning, network teaching)
* Expansion of education across disciplines, including cooperation with industry
* Student recruitment: improvement of visibility, cooperation with upper secondary schools, development of the
admission procedures
* Strengthening of the lower academic degree
* Higher salaries due to the new structure of posts and the general evaluation of academic competence
* Wider course offering enabled by new fields of research

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Department of Computer Science **Url: http://www.cs.helsinki.fi**

COMMON DEVELOPMENT PLANS FOR THE EDUCATION AND DEGREE PROGRAMMES IN MATHEMATICS, PHYSICS, CHEMISTRY AND COMPUTER SCIENCE

Based on this self-evaluation, the Departments have planned the following common activities to develop teaching on the Kumpula campus.

Campus cooperation

As of 2004, the new location on the Kumpula campus of the Departments of Mathematics and Computer Science will enable new teaching cooperation and the implementation of new teaching modules. A new form of teaching includes combining the minor subject studies in Mathematics, Applied Mathematics, Computer Science and Statistics into a single minor subject in the methodical sciences, which would serve the campus as well as the whole University. The goal is for minor subject teaching in the methodical sciences to particularly cater for the parties applying the disciplines both in Kumpula and on other campuses. Course contents are decided in cooperation with representatives of the applying disciplines. Resources for this kind of minor subject teaching would include resources of the methodical sciences, as well as resources from the departments participating in the project. The starting point could be a "study receptacle of the Methodical Sciences", which would include at least 35 credits worth of studies in each science. Students could use this basket to select a minor which can be recognised in the student's discipline. The content of coordinated minor subject studies in the methodical sciences is planned in cooperation with the parties applying these sciences. The studies aim to increase the knowledge of methods in Kumpula and the rest of the University. One of the important tasks of the Faculty's development committee of teaching is to launch related development work. The close location of the departments will further benefit students, as they no longer have to spend a lot of time moving from one department to another.

New teaching technologies, virtual university

Up-to-date computer classes and modern library services enable the introduction of new forms of teaching on campus. In 2002, training for staff and students will be launched to make full use of these forms. The departments have already started to use forms based on network teaching with the help of the Faculty's appropriations for the development of teaching. This has been particularly useful for students and teachers in working life. The goal is to develop new forms of teaching and learning by making use of new information and communication technology, as well as hyper- and multimedia.

Development of feedback systems

The Faculty has collected feedback from teaching and learning in commonly agreed ways. In addition, departments have created their own methods. Once the departments are located on the same campus, the goal is to survey the advantages and disadvantages of the methods used and use them to develop as functional a system as possible. Students play a significant part in this development work.

Teacher training

The Faculty's departments, which will be located on the same campus as of 2004, will form the most significant teacher training environment for mathematical disciplines in Finland. The number of teachers graduating in these disciplines is not big enough to replace the big age groups retiring in the near future. Special funding granted by the Ministry of Education has been used to arrange further training for unqualified teachers. In addition, a special direct entrance system for students interested in

the teacher training option has also been tried out. Didactic research has been developed and new posts have been created in teacher training. Teaching staff must be qualified if interest in mathematical disciplines is to be aroused in upper secondary school pupils. Because of this, the departments on campus will invest heavily in teacher training in the near future.

Student selection

Obtaining a motivated student base is a big challenge for the mathematical disciplines. The development of entrance system mentioned in the overview will be continued on the basis of feedback received on the current methods. The year 2000 saw the launch of a national common student selection, which aims to improve the visibility and attractiveness of the disciplines.

APPENDIX 1

STUDENT ORGANISATION STATEMENTS TO BE APPENDED TO THE SELF-EVALUATION REPORT

Statement by student organisation Matrix ry concerning the status of teaching and studies

This statement has been drafted for Matrix ry by Robert Service and Åsa Ekman

Teaching

The courses offered by the Department of Mathematics at the University of Helsinki are usually made up of lectures and problem-solving classes. Some courses at the intermediate level include supervised groups in which students solve problems and discuss course-related theory with the supervisor. Teaching is supported by assistants' duty hours. Compared to other departments at the University, courses are easy to complete independently. Summer courses for major subject students are, however, arranged only randomly.

While the mathematical skills of lecturers are of a high level, the level of educational skills varies considerably. The supervised groups in the courses Differential and integral calculus I.1 and I.2 have met with approval and students have hoped for similar arrangements in other intermediate-level courses, since small group teaching is rare except for some advanced-level special courses.

The quality of the study material varies depending on the course. The Department's library does not offer textbooks used in basic courses.

Study guidance

Students of the Department of Mathematics at the University of Helsinki have exceptional freedom and responsibility to design their own studies on the basis of their own skills and interests. It is, for example, possible for two graduates to have only 22 credits of major subject studies in common (of the minimum requirement of 93 credits, or 75 credits in the teacher option). In other words, study guidance could be more active.

At the beginning of studies, new students are assigned to student tutors, who, however, mostly focus on the social aspects of student life and on introducing the physical environment of the University. By working in closer cooperation with tutors, the Department could make better use of this contact channel to new students.

Special challenges for the teaching of Mathematics

Compared to other universities offering teaching in Mathematics and technical fields, the University of Helsinki has little visibility in society. The promotion of studies in Mathematics among upper secondary school pupils is nearly non-existent compared to the activities of universities that offer engineering education. This has led to exceptionally low admission requirements at the Department of Mathematics. Many new students have applied primarily for another study place, but have not been accepted. As a result, the number of MSc degrees is small compared to the number of students accepted to the Department.

Our society obviously needs mathematical skills. University teaching in Mathematics has an important double significance. Producing mathematicians required by businesses and society is a direct continuation of thousands of years of tradition in mathematics. By promoting itself more actively, the Department would certainly find a larger number of motivated students and the number of dropouts would decline.

Statement by student organisations on the status of teaching and studies at the Department of Physical Sciences

Student opinions were surveyed with a questionnaire in early October. The survey resulted in approximately twenty responses. The responses of the General division were compiled by Kaisa Kisko and Jyrki Martikainen, those of Theoretical Physics by Harri Waltari, and those of Geophysics by Emilia Koivisto. This summary was prepared by Juha Kummu.

Teaching and learning environment

The educational skills of teaching staff were characterised as varying, but mainly good. Some students proposed educational studies for lecturers.

Study material was generally felt to be quite good. Finnish textbooks (published by Limes) have a good price-to-quality ratio, although they are sometimes too compact. The literature in English received praise, although students in the Department of Theoretical Physics found it to be too wordy. Students were also satisfied with lecture notes. No problems were found in relation to teaching technology, but students hoped that Web resources (mainly course homepages) could be developed.

Teaching has been divided relatively evenly across the week and different months. Exams, however, are usually arranged around the same time, which some students feel cause problems. The division of studies into different terms is considered a good idea. Problems have been caused mainly by popular minor subject courses overlapping with the Department's own courses: for example, the course on Mathematical tools (and the second-year course in Electronics) on Tuesday overlaps with both the Universe Now course in Astronomy and the course Differential and integral calculation I.1 in Mathematics. Departments need to coordinate their planning to avoid such overlaps. Students also hoped for longer opening hours for libraries and computer labs.

Summer study options are limited to minor subject studies, exams and laboratory work. Students showed some interest in a wider range of summer studies, for example, in the form of intensive courses.

In general, students consider themselves to be students of the Department or the Faculty and, according to their own words, are satisfied. Some, however, felt very small in the big community.

Evaluation of learning

The course completion options (mid-term exams + problem-solving exercises, or a final exam) were considered relatively suitable and flexible. Some students praised the compulsory problem-solving classes. On the other hand, some felt that the right to take exams in the basic courses of Physics should be granted more easily. The course offering in Geophysics was considered too limited, which likely depends on the small size of the Division.

Study guidance

The main channels of study guidance include the tutor, teaching programmes and other similar documentation, as well as fellow students. Some students have asked for advice from the student

adviser and the teacher tutor (in Astronomy). Students in the research option considered their supervisor to be a major source of information.

The teaching programme was described as comprehensive, but somewhat difficult to interpret. One student wished for a person with whom to discuss study progress and planning; individual teacher tutors, for example, for second-year students, would certainly help the average student find out more about specialisation options and studies after the second year.

Student tutor activities were felt to be very positive and useful for studies as well as for social life. Tutors introduced their students to the Department, the University, and studies mainly by talking about their own experiences.

Interaction between student and teacher

While only a few students had been in touch with lecturers, no one who had contacted them had poor experiences of it.

Students were generally speaking satisfied with the way in which they were taken into account. Deficiencies were mainly found in overlapping courses. Agreement has usually been reached concerning exam times, etc., and many lecturers try to survey students' skills during lectures.

Feedback system

While most students said they could provide feedback, the actual feedback system was not highly valued. Anonymous feedback collected, for example, in connection with lectures, is the preferred option.

Credit allocation

Students found the workload in laboratory work to be too big in view of the credits awarded. No other big problems were found. On the other hand, some complaints were voiced concerning the workload of problem-solving classes compared, for example, to the Department of Mathematics.

Study progress

The main factor causing delays to studies was felt to be other work. The only solution to this is probably an increase in student aid and other student benefits.

October 31, 2001

Resonanssi ry
Juha Kummu, Chairperson

Geysir ry
Emilia Koivisto, Chairperson

Statement by Helsingin Yliopiston Kemistit ry and Spektrum rf

The extensive intermediate studies of the degree programme in Chemistry are common to all students and form a good basis for the degree. The degree structure in Chemistry was reformed a year ago by increasing the number of elective courses, which students have been satisfied with. Some of the compulsory intermediate-level courses were made elective, and courses in Analytical and Polymer Chemistry, as well as Radiochemistry, were included for the first time in the range of elective courses. Minor subjects can now be freely selected, thus enabling students to put together their degrees more freely according to their own interests and with consideration to labour market needs. The Department's minor subject options in Applied Chemistry and Environmental Chemistry have also received praise as they offer students a wider perspective of Chemistry.

The level of teaching in intermediate studies varies, but students are mostly satisfied with course content and the number of credits awarded. Problems have resulted from laboratory work in Physical Chemistry, in which the workload is not in proportion to the credits awarded. This is caused particularly by the time-consuming laboratory reports. It would be a good idea to provide instruction on report writing, for example, in connection with the corresponding lecture course. As these are the first "real" laboratory reports in the studies of Chemistry, detailed advance guidance would be essential. Distributing a model report (a report about an assignment that resembles the course assignments but is not carried out in reality) would be of great help. Laboratory reports are strenuous and time-consuming also because most students are not familiar with the required computer applications. Appropriate instruction in the applications would therefore be extremely useful. One solution would be to arrange a separate computer course for students of Chemistry, which would also be of use in courses other than Physical Chemistry. The Department's own courses do not include teaching in the flexible use of computer applications. In spring 2001, appropriations connected to the "With Support and Skill" project were used to arrange a course on Word and Excel for first-year students. The course proved to be a success despite the fact that no credits were given for it. Big computer courses may, however, be difficult to arrange due to the limited amount of space available. Students have also found the grading of intermediate-level laboratory reports to be inconsistent: the requirement level varies depending on the assistant reviewing the report. Assistants should have common guidelines for the revision of reports.

Students at the intermediate level have hardly any connections with research and the threshold to independently acquainting oneself with research laboratories is quite high. The advanced studies in Chemistry include a special assignment which provides students with the opportunity to get acquainted with research work and which sometimes can be completed outside the Department. Both the special assignment and thesis guidance have been criticised: students have hoped for more continuous guidance, constructive criticism, and more positive feedback. Students are mostly satisfied with the teaching provided in advanced studies.

Students have been satisfied with the flexible exam practices at the Department of Chemistry, but have hoped for final exams of the laboratory execises in the intermediate studies of Physical Chemistry to be arranged more frequently. Swedish-speaking students cannot always get exam questions in their mother tongue, and sometimes the Swedish used has been poor.

The development of the Kumpula campus will help students of Chemistry: popular minor subjects will be taught near the Department. The new Physicum building now houses a bigger and better library, but as a result of the library moving away from the Department, no reading rooms were left for students. Small group work requires a specially designated space: for example,

problem-solving exercises are currently done mainly in the cafeteria. In general, the Department's facilities meet student needs: the Department is new, the lecture halls are roomy and the teaching laboratories are modern. Students have their own space and both student organisations have a locked office at their disposal.

The job description of teacher tutors does not seem to be quite clear to new students, student tutors, or even teacher tutors themselves. Teacher tutors seem too distant to first-year students as they are rarely in contact with new students during lectures and therefore remain unfamiliar during the first two years of studies.

Students of Chemistry have good chances to exercise influence, for example, in the departmental steering group. Many other working groups in the Department also have student members. Course feedback is collected through feedback forms in connection with exams, and a special feedback event for discussing topical events is arranged every spring. The general feeling is that staff is interested in students and listens to them.

On behalf of Helsingin Yliopiston Kemistit ry and Spektrum rf

Elina Haavisto
HYK ry, Chairperson

Maria Lindén
Spektrum rf, Chairperson

Ilona Ahonen
HYK ry, Communications

Jonas Hartman
Spektrum rf, Director of activities

Statement of the student organisation of Computer Science, TKO-äly ry, to be appended to the self-evaluation report of the Department of Computer Science

E-mail: TKO-aly-nobles@Helsinki.FI

Teaching and studies

Forms and methods of teaching

The strengths of the Department of Computer Science include abundant small group teaching in the form of problem-solving exercises and assignment groups. Personal guidance is provided in practical assignments and in the course on scientific writing.

Course completion

The amount of teaching offered is sufficient. All courses can be completed either through lectures or small group teaching, and many of the compulsory basic courses are taught twice a year.

Separate exams are an easy way to complete courses, as several exam opportunities are offered every year. However, taking book exams to complete courses is not particularly recommended.

Practical training is an essential part of the studies in Computer Science, and problem-solving exercises are felt to be useful. Courses in which students get extra points for problems solved, encourage students to do the exercises. Alternatives to traditional problem-solving classes are offered mainly in elective special courses.

Credit allocation

The workload in courses that include a practical assignment is often not in proportion with the credits awarded.

Internationalism and bilingualism

Student exchange has become more popular both among the Department's own students and students from other universities. The Department's student exchange is well organised and it is easy to participate in student exchange programmes. Recognition of studies completed abroad is also flexible.

Course grading

The grading basis for exams is mainly published on the Web and a feedback meeting is usually arranged after exams, where students can review their grading. Students have not always received sufficient information on feedback meetings.

The publication of exam results is sometimes delayed for longer than the one-month deadline, even in courses other than mass lectures with many students.

Study guidance

Counselling and support of studies

Counselling is offered to students who take the initiative and seek it.

Most of the Department's students start to work in addition to their studies around the second year of studies. The limited amount of teaching held in the evenings may slow down the study progress of students who work.

Initiation of studies

The large number of students admitted to the Department causes some difficulties early on in studies. The new intensive form of the "Introduction to the Use of Computers" course is likely to make the beginning of studies easier, as are the changes made to the orientation event of new students.

Teacher tutoring

Many students feel that the personal guidance provided by teacher tutoring is more useful than group meetings. Teacher tutoring offers information to students and may further their commitment to graduate. Preparing a written study plan helps students to observe the progress of their studies and to clarify their goals.

Study progress

Dropping out usually depends on students themselves and is voluntary. For example, since students may find good employment even without a degree, they may feel persuaded to leave their studies.

Sometimes individual courses may form a bottleneck to studies and thus weaken study motivation.

Teaching and learning environment

Communication and study material

Communication in the Department works well: the Web pages are comprehensive and they are kept up to date. Lecture notes and overhead material used in classes are available on the network, which makes practical assignments easier to complete. Information is usually easy to find on the Department's Web pages.

The teaching programme is published well in advance in electronic format and is regularly updated. The Department has prepared thesis instructions and guidelines for practical assignments, both of which are available on the Internet.

In many courses, paper copies of lecture notes can be purchased at a good price.

Teaching tools

The tools in use are modern. Data projectors and computers are commonly used at lectures and in problem-solving classes, which is a great advantage particularly when discussing programming assignments.

Languages of instruction

A sufficient amount of teaching is offered in English. English-speaking exercise groups in basic courses are arranged at least once a year, and supervisors provide guidance in English, as needed. Advanced courses are taught in English if participants include foreigners.

The “Introduktion till datorn som arbetsredskap” (“Introduction to the Use of Computers”) course, a group in the scientific writing course, and occasional problem-solving groups constitute the only teaching held in Swedish.

Teaching periods

Study plans are flexible to make, as courses can be completed in mid-term. However, the half-term courses created as a result of the degree reform may sometimes be too intensive.

Laboratory courses and the software engineering project, all of which require intensive work, can also be completed in the summer. This enables students to concentrate better on their task.

Facilities and equipment

The Department’s computer labs have modern equipment and a sufficient number of computers.

The Department has a good library with a copy of all the main textbooks for reference use. Students should be able to loan textbooks for a few days or over the weekend. The staff sometimes keeps books reserved unreasonably long.

Students have their own study space and coffee room at the Department.

Teaching staff

The level of teaching in the Department is good, and several of the Department’s excellent teachers have been awarded for their teaching merits. Lecturers are academically qualified and hold lectures proficiently.

Students benefit from the young fee-paid teachers and assistants in the Department. The atmosphere of problem-solving classes, in particular, is good and more relaxed if supervisors can put themselves in the student's position and still remember which topics were difficult to learn and understand.

Students in departmental cooperation

Students could be more committed to their studies in the Department. The challenges faced by the Department include raising its status among students and developing the Department's image compared to other educational institutions.

To promote commitment to the Department, the Department offers students employment opportunities during their studies. Students are recruited as fee-paid teachers, and they can join research groups even before graduation.

Cooperation

Cooperation with businesses does not show in teaching: only a few visiting lecturers from businesses participate in teaching and if they do, they hold lectures in special courses. Students have enough business contacts through their work.

The departments of Mathematics and Computer Science share much of the same student base in the form of major subject students, but cooperation between the two departments is scarce – especially in teaching. This group of students is as yet an unused opportunity.

As Computer Science is a useful minor subject for students of various fields, minor subject studies have not been restricted much by the Department. Minor subject students can also contribute with new points of view.

Practical training for working life

Students in the field do not have problems finding professional work experience. In addition to the jobs in the private sector, students may also participate in the state-supported training period. The Department's research groups also employ summer trainees.

Quality of degree

The degree completed in the Department is of high quality and nationally as well as internationally comparable. The subjects taught should not be trivialised in order to achieve more degrees. The Department should aim to maintain the current degree requirements. Study modules are well designed and form a clear path. Generally speaking, the degree offers good skills for working life.

Appendix 2

Theses

A. Mathematics

Master's - Theses 1.1. 1999 – 8.11. 2001

1999: General Mathematics sub-programme (17)

Kemppinen, Juha: *Elliptiset integraalit ja elliptiset funktiot* (mcl)
Tomperi, Teemu: *The Impulse Response of the Radio Channel* (mcl)
Hänninen, Teemu: *Bergmanin avaruudet yksikkökiekolla* (ecl)
Hari, Kaisa: *Funktorien esitykset ja rajat* (cl)
Hästö, Peter: *Weighted Trudinger—type Inequalities in Irregular Domains* (ecl)
Paile, Viktor: *Några tillämpningar av singulär homologiteori* (cl)
Airio, Tony: *Lyapunovin eksponentit* (ecl)
Erkkilä, Paula: *Kvasikonformikuvauksen derivaatan integroitumisasteesta* (mcl)
Mukkila, Susanna: *Laajennettu täydellisyyslause ja Craigin interpolaatiolause* (luba)
Viljanen, Joose: *Yleistetyt kvanttorit ja oraakkelit deskriptiivisessa vaativuusteoriassa* (mcl)
Päivinen, Mikko: H*ausdorffin mitta ja yhtenäisyys* (mcl)
Honkaharju, Harri: *Maariskien asiantuntijajärjestelmä - Sumean logiikan matemaattiset perusteet* (mcl)
Kaartinen, Janne: *Uniformiset alueet* (cl)
Hälikkä, Sasu: *Characterization of L^p-averaging domains* (cl)
Mäkelä, Totti: *Kolmivalenttien verkkojen isomorfiaongelmasta* (ecl)
Tietäväinen, Juha—Pekka: *Kompositio—operaattorit Hardy-avaruuksissa* (ecl)
Goebel, Roman: *Invariantly Uniformizable Topological Spaces* (l)

1999: Applied Mathematics sub-programme (18)

Smolander, Visa: *Epälineaarisen regression menetelmistä* (ecl)
Alaviitala, Riina: *Kollektiivin käsite riskiteoriassa* (nsla)
Hopea, Minna: *Markov—päätösprosessien käyttö vakuutusmatematiikassa* (cl)
Lindroos, Petri: *An autoregressive model for low bit rate video* (cl)
Rantala, Enrico: *Simulation of Carrier-to-Interference Ratio in 1/3 Reuse Cellular Networks* (ecl)
Erästö, Panu: *Lämpötilan rekonstruointi järvien pieneliölajien suhteellisista osuuksista* (mcl)
Koivusaari, Jukka: *Integraaliepäyhtälöitä konkaaveille funktioille* (cl)
Rantanen, Riitta: *Informaatiokanava* (cl)
Blomster, Toni: *Informaatioteoreettinen riski-indeksi* (ecl)
Partanen, Juha: *Muodon säilyttävä interpolointi* (nsla)
Mäkinen, Mika: *Logaritmisoptimaalinen sijoitusstrategia osakemarkkinoilla* (cl)
Filpus, Santtu: *Lineaaristen yhtälöryhmien ratkaiseminen iterointikeinoilla* (cl)
Hakkola, Jari: *Monotoninen sovittaminen* (mcl)
Eskola, Milja: *Singulaariset häiriökehitelmät tavallisten differentiaaliyhtälöiden ratkaisujen approksimoinnissa* (mcl)
Eskelinen, Tiina: *Sijoitusriskit ja moderni portfolioteoria, sovellutuksena työeläkejärjestelmän vakavaraisuussäädökset* (mcl)
Ojala, Jussi: *Frequency-non—selective (flat) multipath-fading* (mcl)

Sallasmaa, Eero: *Odotusarvo--varianssi—optimointimenetelmän käyttö portfolioanalyysissä* (mcl)
Honkaharju, Marko: *Optimaaliset koesuunnittelut ja design-kriteerit* mcl)

1999: Teacher of Mathematics sub-programme (20)

Sauvonsaari, Jari: *Jatkuvat kuvaukset ja homotopia* (cl)
Kokkonen, Päivi: *Splinifunktiot* (mcl)
Tommola, Teemu: *Galois'n teorian perusteet* (ecl)
Tamminen, Aki: Sobolevin epäyhtälö konveksissa alueessa (ecl)
Urho, Ritva—Liisa: *Yksinkertaiset kryptosysteemit ja niiden kryptoanalyysi* (mcl)
Lehtonen, Jukka: *Geometrian peruskäsitteet lukion matematiikassa* (cl)
Saastamoinen, Kalle: *Kompaktisuuslauseen todistaminen, Boolen algebra ja filtterit* (cl)
Luoma, Sinikka: *"Mä inhoan matikkaa", yhdeksäsluokkalaisten asenteita matematiikkaa kohtaan Suomessa ja Ohiossa* (mcl)
Karhu, Veli: *Kartioleikkausten perusominaisuudet ja Apollonios* (mcl)
Niilola, Kirsi: *General Inequalities* (ecl)
Aho, Seppo: *Kotitaustan yhteys lukiolaisen valintoihin ja menestymiseen matematiikassa* (cl)
Helminen, Mia: *Trudingerin epäyhtälöstä* (mcl)
Virrankoski, Reino: *Laskentaohjelmistojen hyödyntäminen digitaalisen opetusmateriaalin laatimisessa. Optimointia MAPLE—ohjelmalla* (ecl)
Lindholm, Robert: *Talteori- ett kompendium för en valbar kurs på gymnasiet* (mcl)
Virtanen, Jani: *Tavalliset differentiaaliyhtälöt - opetusmoniste lukioon* (mcl)
Koskinen, Sami: *Differentiaaliyhtälöt lukiossa. Opetuspaketti.* (nsla)
Pulkka, Heidi: *Yläasteen oppilaiden kokemuksia matematiikan opetuksesta* (mcl)
Ovaska, Petri: *Arvio kvasihyperbolisen geodeesin pituudelle* (ecl)
Starzacher, Hatsi: *Tilastollisen riippuvuuden opettaminen lukiossa* (cl)
Kivelä, Erno: *Laskettavuuden perusteet URM- koneen avulla* (cl)

2000: General Mathematics sub-programme (15)

Astola, Laura: *Tietokoneavusteinen visualisointi matematiikan opetuksessa* (cl)
Virtanen, Jani: *Fredholm operators and the West decomposition of Riesz operators* (ecl)
Kontinen, Juha: *Korekursio ei--hyvinperustetuilla joukoilla* (ecl)
Seppänen, Jouni: *Bonferronin epäyhtälön käyttö assosiaatiosääntöjen yleistämisessä* (l)
Korppi, Tuomas: *Cech homology with coefficients in a non--standard model of the theory of integers* (l)
Pennanen, Juho: *Self-organized criticality of the first fire model* (cl)
Liu, Song: *The Hardy--Littlewood maximal function and its numerical computation* (mcl)
Rasila, Antti: *Hyperaritmeettisuus* (mcl)
Koistinen, Ari: *Ergodisista systeemeistä ja itsesimilaareista fraktaaleista* (ecl)
Jokelainen, Jussi: *Alkuluvut - mainio juttu* (ecl)
Pankka, Pekka: *Geometrinen lähestymistapa Eulerin luokan määrittämiseen komplekseilla monistoilla* (ecl)
Jokela, Teemu: *Jordanin käyrälause tasossa* (ecl)
Nieminen, Pekka: *Martingale approach to harmonic conjugation* (l)
Laitila, Jussi: *BMOA and compact composition operators* (ecl)

Viherä, Jussi: *Kuvauksen aste* (luba)

2000: Applied Matemathics sub-programme (8)

Moilanen, Jani: *Performance of Hyperbolic Location Calculation Algorithms in GRM Network* (ecl)
Lehtonen, Antti: *Handover Delay in WCDMA* (ecl)
Ahola, Katja: *Kuolevuuden estimointi suurimman uskottavuuden – menetelmällä* (cl)
Muhonen, Jukka: *Monen Bayes -pelaajan pelaamat vajaan informaation pelit* (mcl)
Marjomaa, Esko: *Utiliteettiteorian perusteista ja ongelmista* (cl)
Auvinen, Harri: *Adaptiivinen MCMC –menetelmä korkea-ulotteisissa avaruuksissa* (ecl)
Salonen, Teppo: *Vedonlyöntiteoria* (mcl)
Virkkunen, Mikko: *Black—Scholesin hinnoittelumalli eurooppalaisille optioille* (mcl)

2000: Teacher of Mathematics sub-programme (26)

Jurvanen, Mika: *Lukujonot lukion pitkässä matematiikassa* (cl)
Morander, Sanna: *Opetusmoniste alkeisfunktioista* (mcl)

de Silva Kati: *Potentiaaliestimaatteja* (cl)
Hietala, Mikko: *Sobolevin funktioiden approksimoinnista* (mcl)
Mikander, Milla: *Opetusmoniste sarjoista lukioon* (mcl)
Hagros, Marika: *Helsingin yliopiston matemaattis-fysikaalis-kemiallisten tieteiden aineenopettajan*
suuntautumisvaihtoehdon valintakokeilu (ecl)
Piira, Saila: *Funktion kulun tutkiminen derivaatan avulla (opetusmoniste lukiotasolle)* (cl)
Kontu, Tuula: *Derivaatan opetus lukiossa. Pitkä matematiikka.* (mcl)
Kaski, Anniina: *Funktion jatkuvuuden opetus lukiossa* (cl)
Sytelä, Jyrki: *Tilastomatematiikan alkeet* (cl)
Alatupa, Sami: *Opialin epäyhtälöstä* (cl)
Halme, Antti: *Kompleksiluvut lukion pitkän matematiikan opetuksessa* (ecl)
Karpin, Miika: *Opetusmoniste lukion laajan matematiikan jatkokurssille. "Väliarvolause ja sen sovellukset"* (cl)
Kalliala, Marjukka: *Tasogeometrian opetus peruskoulussa ja oppikoulussa* (cl)
Spåra, Mika: *Matemaattisen aineiston julkaiseminen internetissä, julkaisuna hypertekstipohjainen*
oppimateriaali luonnollisten lukujen jaollisuudesta (mcl)
Hirvonen, Katri: *Derivaatan käsitteen konstruointi graafisen laskimen avulla lukion lyhyessä matematiikassa* (ecl)
Kaila, Anja: *Absoluuttisesta jatkuvuudesta ja Sobolev—funktioista* (mcl)
Saarilehto, Sanna: *Polynomi lukion pitkän matematiikan opetuksessa* (luba)
Pesonen, Päivi: *Lukujonot ja sarjat lukion pitkässä matematiikassa* (mcl)
Hiltunen, Heikki: *Matemaattisen mallintamisen ja ongelmaratkaisun välinen yhteys - tehtäväsarja 6.-9.*
luokkalaisille oppilaille (mcl)
Pitkälä, Pirjo: *Raja-arvon käsittely lukion oppikirjoissa* (cl)
Norja, Jukka: *Boolen algebra ja Stonen esityslause* (nsla)
Pajo, Antti: *Transkendenttiset alkeisfunktiot lukion pitkän matematiikan oppimäärässä* (cl)
Nordman, Pia: *Flickor och matematik* (cl)
Tiainen, Jarkko: *Miten erilaiset opetusmenetelmät vaikuttavat prosenttilaskujen oppimiseen yläasteella*

(ecl)
Sjöroos, Toni: *HyperText Markup Language matemaattisen hypertekstin julkaisumuotona, julkaisuna*
hypertekstipohjainen oppimateriaali rationaaliluvuista (mcl)

2001 (before 8.11.): General Mathematics sub-programme (5)

Mattila, Petri: *Round-Robin Scheduling in Packet-Switching Networks* (ecl)
Anttila, Tatu: *Banach-Tarskin paradoksi* (ecl)
Linden, Henri: *Lefschetz' fixpunktsats för kompakta polyheder* (mcl)
Savio, Sami: *Tasoalueen täyttävistä kuvauksista* (cl)
Lönnqvist, Henrik: *Elementära bevis av Brouwers fixpunktsats och Jordans kurvsats* (ecl)

2001 (before 8.11.): Applied Mathematics sub-programme (6)

Grönholm, Katarina: *WCDMA Indoor Simulations* (mcl)
Tanskanen, Antti: *Heurististen optimointimenetelmien käyttö luonnonsuojelualueiden valinnassa* (mcl)
Imppola, Anu: *Työkyvyttömyysvakuutus pitkäaikaisen vakuutussopimuksen erikoistapauksena* (cl)
Niemi, Olli: *A C++ Software Library for Numerical Linear Algebra* (mcl)
Henttonen, Tero: *Compressed Mode in WCDMA* (ecl)
Linnakangas, Arja-Liisa: *Monotoninen Hermiten interpolointi* (nsla)

2001 (before 8.11.): Teacher of Mathematics sub-programme (15)

Harju, Jukka: *Lineaarialgebrakirjasto C++-kielellä* (mcl)
Savolainen, Irene: *Transkendenttiset alkeisfunktiot lukion matematiikassa* (nsla)
Koskinen, Taru: *Piin käsite ja ympyrän pinta-ala ylästeen matematiikassa – konstruktivistinen lähestymistapa* (mcl)
Kirkanen, Toni: *Mielenkiintoinen ja havainnollinen matematiikka – ideoita matematiikan opetukseen* (cl)
Oikarinen, Ville: *Taltta – laskuntaidonopiskeluohjelma* (cl)
Leppälä, Mialeena: *Konveksien funktioiden karakterisointeja* (cl)
Arvela, Harri: *Differentiaaliyhtälöiden ratkaisujen olemassaolo minimioletuksin* (mcl)
Pantsar, Merja: *"Opettaja, anna kaava" – näkökulmia potenssin, juuren ja logaritmin oppimisesta* (mcl)
Löfman, Paula: *Kuvausten jatko- ja konvergenssilauseita metrisissä avaruuksissa* (cl)
Sauna-aho, Eila: *Ernst Lindelöf* (mcl)
Harjunpää, Jari: *Opetusmoniste geometristen ongelmien ratkaisemisesta peruskoulun yläasteella Cabri-*
Geometre II tietokoneohjelmalla (cl)
Selvenius, Sirkka: *Elinvoimainen tieto – lukualueen laajentaminen negatiivisiin lukuihin suomalaisissa*
matematiikan oppikirjoissa (nsla)
Snellman, Riitta: *www-sivujen käyttö yläasteen matematiikan opetuksessa* (mcl)
Halme, Essi: *Matematiikan elävöittäminen tarinan keinoin* (mcl)
Uusitalo, Sakari: *Polynomien nollakohtien sijainnista* (mcl)

Marks of the Pro gradu (Master's) theses: l = laudatur, ecl = eximia cum laude appro-batur,

mcl = magna cum laude approbatur, cl = cum laude approbatur, nsla = non sine lubenter approbatur, luba = lubenter approbatur, a = approbatur.

B. Physics and Astrophysics

Physics

Ph.D. Theses 1999

Abo Ramadan, Usama, A study on the improvement of inherent and enhanced tissue contrast in MR
imaging using MT and SL techniques
Arstila, Kai, Experimental Study of Electronic Stopping Powers for Heavy Ions
Aschan, Carita, Applicability of thermoluminescent dosimeters in X-ray organ dose determination and in
the dosimetry of systemic and boron neutron capture radiotherapy
Battaglia, Marco, Study of Rare Decays of the b Quark with the DELPHI Detector at LEP
Bogdan, Anatoli, Experimental and theoretical study of ice nucleation in finely divided water droplets
Havukainen, Martti, Quantum simulations of atom-photon interactions
Heinäsmäki, Sami, Radiative and nonradiative X-ray and ultraviolet scattering
Kangasmäki, Aki, Electromagnetic decay properties of mid-*sd*-shell nuclei
Karjalainen, Milja, Structural Studies on Polymer Membranes and SrS Based Thin Films
Keränen, Petteri, Aspects of massive neutrinos in astrophysics and cosmology
Kosunen, Antti, Metrology and quality of radiation therapy dosimetry of electron, photon and epithermal
neutron beams
Nikkinen, Päivi, Single photon emission tomography in neurological studies: instrumentation and clinical
applications
Sievänen, Olli-Pekka, Numerical investigations in spectral and signal space of Raman spectra and of
simulated ion bombarded surfaces
Slotte, Jonatan, Diffusion of impurities and vacancies in compound semiconductors
Torri, Pauli, Structure and properties of MoSi2 and Mo-Si-N based nanocomposite coatings
Virkkula, Aki, Field and laboratory studies on the physical and chemical properties of natural and
anthropogenic tropospheric aerosol

Ph.D. Theses 2000

Buzorius, Gintautas, Variation of aerosol concentration in ambient air
Helminen, Christina, Aspects of the quark model for the baryons
Kuisma-Kursula, Pirkko, PIXE and SEM studies of old Finnish and European glass and European oyster
Ostrea edulis
Lampinen, Juha, Calculating patient specific doses in X-ray diagnostics and from radiopharmaceuticals
Laukkanen, Jarkko, Advanced experimental methods in Compton scattering spectroscopy
Lihavainen, Heikki, A laminar flow diffusion chamber for homogeneous nucleation studies
Lindén, Tomas, Strangelet search and particle production studies in Pb-Pb collisions at 158.A GeV/c with
the H6 beamline spectrometer at CERN

Napari, Ismo, Density functional theory of nucleation and phase behaviour in binary fluid systems
Pekko, Panu, Experimental studies of tetrahedral amorphous carbon coatings
Puolamäki, Kai, Breaking of R-parity and supersymmetry in supersymmetric models
Sillanpää, Jussi, Phenomenological model for electronic stopping of low-velocity ions in crystalline solids
Tarus, Jura, Effect of the surface on irradiation induced damage in covalently bonded materials
Toppila, Esko, A systems approach to individual hearing conservation
Torkkeli, Mika, SAXS studies on ionomers and polymer-amphiphile complexes
Vainonen-Ahlgren, Elizaveta, Release of hydrogen isotopes from carbon based fusion reactor materials

Ph.D. theses 2001 (till 1.11.2001)

Blomqvist, Johanna, Ab initio and DFT derived potential energy functions in simulations of selected
polyesters based on atomistic models
Harun-or-Rashid, S.M., Cosmological parameters and black holes
Holmlund, Kenneth, Generation and utilisation of quality indicators for satellite-derived atmospheric
motion vectors
Lehti, Sami, Prospects for the detection of neutral MSSM Higgs bosons decaying into tau leptons in the
CMS detectors
Lukkarinen, Jani, Statistical analysis of finite equilibrium quantum systems
Mäkinen, Teemu, SWAN Lyman alpha Imager Cometary Hydrogen Coma Observations
Nurmela, Arto, Non-Rutherford elastic scattering cross sections for materials analysis
Rinne, Janne, Application and development of surface layer flux techniques for measurements of volatile
organic compound emissions from vegetation
Seppälä, Anni, Ion beam channeling studies of compound semiconductor materials
Sihvola, Elina, Big Bang nucleosynthesis with inhomogeneous baryon density and antimatter regions
Soininen, Aleksi, Final state interactions in inelastic x-ray scattering

Licentiate theses 1999

Alander, Jarmo, Protein folding problem, An algorithmic lattice model approach
Saarinen, Ari, EMFi-actuator: Vibro-acoustical consideration

Licentiate theses 2000

Lautala, Raija, Hahmottavan lähestymistavan toimivuus peruskoulun ja lukion aaltoliikeopin opetuksessa

Licentiate theses 2001 (till 1.11.2001)

Kallunki, Veera, From electrostatics to the circuits of the pile: Experimentality and models in concept
formation

M.Sc. theses 1999

Ahvenisto, Ursula, Geofysiikka lukiossa
Hakala, Esko, Teknisen työn ja luonnonopin yhteydet peruskoulun ala-asteen opetuksessa
Helo, Erkki, Polysyklisten aromaattisten hiilivetyjen infrapunaspektrit
Hemming, Samuli, The Energy-Momentum Tensor and Hamiltonian Formalism in Yang-Mills Theory
with Fermions
Herrman, René, Detection of nanotubes and fullerenes in amorphous diamond-like thin films
Hirvonen, Juha, Paperinvalmistuslinjalle suunniteltavan monitorointilaitteen ultraäänisignaalin data-
analyysi
Honkkila, Ville, Kentänmuutosvirran huomioiminen magnetohydrodynamiikassa
Huotari, Simo, Compton-sironta berylliumista
Hyttinen, Annikka, Yläastelaisen kosmologinen maailmankuva ja sen yhteys maailmankuvan historialliseen kehitykseen
Hyvärinen, Liisa, Peruskoulun 7. luokan fysiikan kurssin suunnittelu, toteutus ja analysointi
Jokinen, Asko, Q-pallot ja niiden hajoaminen
Jokisalo, Juha, Faasimuutosrakenteiden lämpötekninen simulointi
Kallunki, Jouni, Surface diffusion and stochastic resonance
Kankaanpää, Merja, Energian monet kasvot
Karppinen, Timo, Tehoultraäänen vaikutus paperin sorptioon
Kauppinen, Kaarina, Peruskoulun yläasteen fysiikan ensimmäisen kurssin suunnittelu ja toteutus
Kiviharju, Pekka, 10000 metrin juoksun vauhdinjaon optimointi
Kolari, Kai, Monikiteisen piiaurinkokennon kiellettyjen energiatilojen passivoiminen
Koskinen, Juha, Digitaalisen radiolinkin lisädatakanavan liitäntä

Kosonen, Mika, ATM-keskuksen käytönohjaustietokone
Laakko, Juhani, Puhelinkeskuksen tietokoneyksiköiden taustaväylän nopeuttaminen purskesiirron avulla
Laakso, Lauri, Ilmakehän ionien ja aerosolien mallintaminen
Lehtonen, Jaakko, Paperin pigmenttipäällysteen hajaheijastus- ja absorptiokertoimen laskeminen mikrokerrosmallin avulla
Lönnqvist, Jukka, Lyhytketjuisten aminohappojen Ramanspektrit
Lönnroth, Nadja, Kolesterolin ja kasvisterolin sekakiteiden rakenteen tutkimus
Mannila, Rami, Mikromekaanisen Fabry-Perot interferometrin soveltuvuus eteenin pitoisuusmittauksiin
Palmroth, Minna, Generation of Equatorial F-Region Bubbles via Rayleigh-Taylor Instabilities
Partamies, Noora, Auroral spirals
Pasanen, Ossi, Heteroottisen säieteorian 5-braaniratkaisuista
Pehkonen, Risto, Voiman hahmottaminen koulufysiikassa
Perhiö, Lasse, Navigoinnin fysiikka - fysiikan navigointi
Pulkkinen, Antti, Modelling of Space Weather Effects on Pipelines
Pusa, Petteri, Optical model in ion elastic scattering near the Coulomb barrier
Repo, Juha-Pekka, Pyreenin ramanspektri
Räsänen, (Jukka) Syksy, BRST symmetry and the confinement problem
Salonen, Emppu, Molecular dynamics simulations of hydrogen bombardment of divertor surfaces in
Tokamak reactors

Seppälä, Miina, Klassisen mekaniikan menetelmien käyttö talouden tuotantoprosessien mallintamisessa:
Konservatiivisen tuotantokentän ja liikeyhtälöiden määrittäminen
Säles, Tuukka, Energeettisten neutraalien atomien havaitseminen avaruusolosuhteissa
Tikka, Mauri, Gravitaation aiheuttama linssi-ilmiö
Toimela, Kari, Aspects on Biphasic External Cardiac Defibrillation Design
Vainio, Veera, Säteilynkuljetuksen teoriaa ilmakehän satelliittimittauksille
Väisänen, Jukka, Käsitekartat fysiikan tietorakenteen esittämisen välineenä

M.Sc. theses 2000

Ahoranta, Jorma, Taulukkolaskentaohjelman mahdollisuudet peruskoulun fysiikan opetuksessa
Asmi, Ari, Ulkoilman pienhiukkaspitoisuuden vaikutus sisäilman pitoisuuksiin
Backman, Ulrika, TiO2 Films Using the MOCVD Method and Turbulent Flow
Bjugg, Hanna, BNCT-annossuunnittelun teoreettiset perusteet
Collin, Anssi, Bose-Einstein condensation and the scattering length in three and two dimensions
Hannelius, Lars-Erik, The Strange Form Factors of the Proton in the Chiral Quark Model
Hiltunen, Marianna, Comparison of Mathematical Methods for the Compound Sample Analysis of
Multicomponent Fourier Transform Infrared Spectra
Himanen, Pasi, Heilurin kokeellinen tutkimus fysiikan opetuksessa
Huttunen, Emilia, Koronan massapurkaukset ja magneettiset myrskyt
Immonen, Jani, Fullereenien esiintymistodennäköisyys amorfisissa timanttipinnoitteissa
Jaatinen, Jussi, Aurinkoa ympäröivän vetypilven tutkiminen SWAN/SOHO mittauksin
Jalarvo, Niina, Multimediapohjaiset oheismateriaalit energiakäsitteen opetuksen tukena peruskoulun
yläasteella
Johansson, Milla, Kastuvan paperin epälineaarinen ultraäänitransmissiomittaus
Juuti, Kalle, Kiehumisen ja höyrystymisen laadullinen ymmärtäminen
Kiili, Petteri, Amorfisten timanttikalvojen kasvatus fullereeni-ionisuihkujen avulla
Kiuru, Mirjami, Plasmasuihkujen kiihdytys ja energian mittaus
Kontinen, Samu, Tähtienvälisten molekyylien pylvästiheyksien johtaminen radiospektriviivahavainnoista
Koponen, Jonna, A Variational Fit to the Lattice Energy of Two Heavy-Light Mesons
Laamanen, Jari, The Particle Limit of Quantum Field Theory Using World-line Path Integrals
Laine, Mikko J., Tiedelehtien fysiikka. Artikkeleiden ymmärrettävyys hahmottavan lähestymistavan
valossa
Lehti, Sanna, Timanttipinnoiterakenteen väsymiskäyttäytyminen

Lindroos, Olavi, Nostetaan Schrödingerin kissa pöydälle
Loikkanen, Juha, Chern-Simons-Witten Theory and its Conformal Field Theoretic Background
Lähde, Timo, Relativistic Description of Heavy-light Mesons
Lämsä, Vili, A soft X-ray Solar monitor for SMART-I satellite
Mannila, Katja, Kokeellisuus ala-asteen ympäristö- ja luonnontiedon opetuksessa
Mattila, Aleksi, Ympyräpolarisoituneen synkrotronisäteilyn magneettinen dikroismi
Mäenpää, Teppo H., Front-end read-out systems for CMS tracker
Niiranen, Anna-Maija, Energiakäsitteiden käyttöönotto ja kehitys fysiikan opetuksessa
Nikki, Sinikka, Hahmottavaa fysiikkaa erityisopetuksessa
Nikunen, Petri, Non-Equilibrium Effects in Profile Evolution Measurements of Surface Diffusion

Nord, Janne, Molecular dynamics study of irradiation effects in GaAs and semiconductor interfaces
Nulpponen, Jari, Konstruktivistisen oppimiskäsityksen huomioiminen peruskoulun yläasteen fysiikan
opetuksessa
Palonen, Vesa, Kiihdytinpohjaisen massaspektrometrin tulostenkäsittely ja tarkkuus
Peltola, Jani, Median tarjoama kuva fysiikasta
Piirola, Pekko, Pioni-nukleoni-sirontapituus GMO-summasäännöstä
Poutiainen, Sanna, Demonstraatiot fysiikan käsitteiden omaksumisen tukena lukiossa
Raita, Tommi, Energia-impulssi-tensori ja kanoninen formalismi Yangin ja Millsin teoriassa
Rantala, Sami, Magneettiset monopolit N=2,4 super-Yang-Mills teorioissa
Rinne, Raili, Yläasteen verkkoympäristössä toimivan valo-opin kurssin suunnittelu
Saaresto, Maaret, Ultraviolettivalolle altistetun ihofantomin multispektrianalyysi
Salmi, Atte, Teräksen pintakarkaisukerroksen kovuusprofiilin määritys termisellä ainetta rikkomattomalla
koestuksella
Salminen, Tomi, Simulating Cosmic Structure Formation
Salonen, Timo, Lukion sähködynamiikan kurssi tietoverkkoympäristössä www-tekniikalla toteutettuna
Savolainen, Hannele, Fysiikan opettajan työnkuva v. 2000
Stenberg, Pirkko, Valoilmiöitä tutkiva fysiikkakerho peruskoulun 5. ja 6. luokkien oppilaille
Suhonen, Hilkka, Ympäristön radioaktiivisuus ydinfysiikan opetuksessa
Suominen, Markku, Kosmologisen vakion vaikutus FRW-malleihin
Torniainen, Ville-Veikko, Haulikkoammunnan fysiikka
Tuomainen, Helena, Fysiikka-kemian opetus valinnaisaineena peruskoulussa ja sen vaikutus jatko-
opintoihin
Valtakoski, Aku, Mathematical aspects of functional integration
Valtchanova, Snejana, Kvantittumisen hahmottaminen peruskoulun fysiikassa
Virrankoski, Ville, Kvarkkien massat
Vuori, Kim, In vivo ^{1}H NMR spectroscopy in human brain
Välimaa, Joni, Helsinki-hiukkasteleskooppi H2-suihkussa
Välimäki, Petteri, Soluklusterimallit mikrodosimetriassa
Väliviita, Jussi, An Analytic Approach to Cosmic Microwave Background Radiation Anisotropies

M.Sc. theses 2001 (till 1.11.2001)

Edelmann, Erik, Förbättring av djupresolutionen i ERDA-mätningar med Bayesisk data-analys
Ehn, Jens, Optical properties of the sea ice and sea water in Santala Bay: measurements and modelling
Eresmaa, Reima, Terminen vuorovesi havainnoissa ja HIRLAM-mallissa
Frantz, Jonas, MD-simulering av strålningseffekter i grupp IV halvledare
Friman, Anri, Ferromagneettisen kappaleen anomaliakentän mittauslaitteen ohjelmisto
Gynther, Antti, Electroweak Phase Transition in an External Hypermagnetic Field
Heinonen, Jukka, Development of Object-Oriented Software for Silicon Strip Detector Data Analysis
Hirvonen, Jaakko, Master Equation Analysis of Island Diffusion on fcc(100) Surfaces
Jokinen, Risto, Abiturienttien atomikäsitys
Karila, Johanna M., Boori-neutronikaappaushoidon dosimetrian laadunvarmistus

Korhonen, Hannele, Orgaanisen aineen kondensaatio aerosolihiukkasiin

Krapu, Mikko, Optisen emissioanalysaattorin kalibrointien siirrettävyys
Kronholm, Henrik, Frekvensmodulation av en optisk injicerad halvledarlaser
Kuusisto, Jorma, Ionisoivan säteilyn opetus pelastushallinnon tarpeisiin
Lappi, Tuomas, Classical Field Methods in Relativistic Heavy-ion Collisions
Lauri, Antti, Klassisen nukleaatioteorian ennusteita binääriselle heterogeeniselle nukleaatiolle
Lauros, Johanna, Tienpinnan talviset liukkausolosuhteet ja niiden mallintaminen
Leinonen, Anne, Juoksu-urheilu koulufysiikassa
Leskinen, Katja, Radioaaltojen monitie-etenemisen aiheuttama taajuusselektiivinen häipyminen ja
signaturemittaus digitaaliselle radiolinkkipäätteelle
Meriläinen, Jussi, Enhancing Pulse Oximeter Design Concerning Motion Artefacts, Pulssioksimetrin
toiminnallisuuden parantaminen liikeartefaktojen suhteen
Mizohata, Kenichiro, Rekyyliatomien spektrometria kaasuionisaatioilmaisimella
Nisula, Seppo, Oppilaan kokemusmaailmaan nojautuva fysiikan opetus peruskoulun 5.-7. luokilla
Ojapelto, Anna-Maija, Fysiikan opetus lähihoitajakoulutuksessa
Olli, Timo, Hypermedian mahdollisuudet fysiikan opetuksessa peruskoulussa ja lukiossa
Peltola, Jarkko, Local and Pair-Specific Models for Electronic Stopping
Porra, Liisa, Keuhkojen kuvantaminen käyttäen ksenon-kaasua kontrastiaineena
Poutianen, Sanna, Demonstraatiot fysiikan käsitteiden omaksumisen tukena lukiossa
Roine, Kristian, Stabiilisuusindeksit ja sää Suomessa
Salmela, Marjatta, Fysiikan historian valinnaiskurssi peruskouluun
Salonen, Kirsti, Doppler-säätutkalla mitattujen tuulihavaintojen käyttö numeerisissa malleissa
Salonen, Mikko, Fysiikka ja muut luonnontieteet keskiaikaisessa Bysantin keisarikunnassa
Sarén, Matti-Paavo, Puun solurakenteen tutkimus
Sihvonen, Tiina, Ajatuskokeiden käyttö fysiikan opetuksessa - nojatuolitutkimuksen avulla itsenäiseen
ajatteluun kannustamista
Soininen, Antti, Plasmakiihdyttimen plasmaenergian mittaus Doppler-menetelmällä
Terämä, Emma, Dynamics and Growth of Grains in Two Dimensional System
Tiinanen, Sinikka, Fysiikan historiaa pakolliseen kurssiin
Uusipaikka, Leena, Modifying the Bioactivity of Amorphous Diamond
Vepsäläinen, Mikko, Large Extra Dimensions and Power Law Unification
Virta, Hanna, Tuulipulssin aiheuttaman kumpuamisen dynamiikka Lammin Pääjärvessä
Vuorinen, Aleksi, Four-loop Feynman diagrams in three dimensions
Öhman, Tuula, Fysiikkaa esikoululaisille

Laudatur theses 1999

Heikkilä, Tarja, Sauna lämpöopin opetuksen lähtökohtana
Torvinen, Marko, Äänimerkkien parametrisoiminen TETRA-järjestelmän PSTN/PABX pistoyksikköön
Tynkkynen, Timo, Pyörillä liikkuvien vaunujen mahdollisuudet dynamiikan peruskäsitteiden empiirisessä
hahmotuksessa

Laudatur theses 2000

Malvikko, Suvi-Päivi, Pollution, meteorology and deposition in some urban areas
Mäkinen, Tuija, Arkhimedeen laki ja kelluminen fysiikan opetuksessa
Sallinen, Matti, Hahmottava lähestymistapa tasavirtapiirien opetuksessa
Tiainen, Kaarina, Kuinka Suomi sähkön sai eli Suomen sähköistämisen historia

Laudatur theses 2001 (till 1.11.2001)

Korhonen, Hannu, Fysiikan alaan kuuluvista käsityksistä Kiinan vanhassa kulttuurissa
Tahvanainen, Jorma, Hahmottava kokeellisuus vaihtovirtapiirien

Astrophysics

M.Sc. and Ph.D. Thesis in English in 1995-2001

M.Sc. Thesis: Hannikainen D., 1995, IUE observations of _ 2 Coronae Borealis with simultaneous VLA and GINGA coverage, (ecl)
Ph.D. Thesis: Juvela M., 1997, Observations and radiative transfer modelling of clumpy molecular clouds, (ecl)
M.Sc. Thesis: Hackman T., 1997, Surface imaging of late type stars, (mcl)
Ph.D. Thesis: Lehtinen K., 1998, Studies of dust and starformation in globules, (mcl)
Ph.D. Thesis: Piironen J., 1998, Photometry of asteroids at small phase angles with related laboratory measurements, (ecl)
M.Sc. Thesis: Keränen S., 1998, Backscattering of light by particulate media, (cl)
M.Sc. Thesis: Torppa J., 1999, Asteroid lightcurve inversion: Methods for obtaining a unique and stable shape solution, (ecl)
M.Sc. Thesis: Virtanen J., 1999, Initial statistical ranging of asteroid orbits in phase space, (ecl)
Ph.D. Thesis: Hannikainen D., 1999, Multiwavelength studies if radio-jet X-ray binaries, (mcl)
Ph.D. Thesis: Nevalainen J., 2000, Determining cosmological parameters using X-ray analyses of clusters of galaxies and the Cepheid period-luminosity relation, (ecl)
Ph.D. Thesis: Väisänen P., 2001, Infrared properties of galaxies and constraints on galaxy evolution, (ecl)
M.Sc. Thesis: Johansson, P., 2001, Infrared and dynamical studies of interacting galaxies, (ecl)
ximia

M.Sc. and Ph.D. Thesis in Finnish in 1995-2001

M.Sc. Thesis: Palviainen A., 1997, Tähtien synty Linnunradan tason ulkopuolella, (mcl)
M.Sc. Thesis: Kahanpää J., 1999, Pölyn vaikutus säteilynkuljetukseen spiraaligalakseissa, (ecl)
M.Sc. Thesis: Schultz J., 1999, Monte-Carlo-simulaatioita kertymäkiekkojen polarisaatiosta, (ecl)
M.Sc. Thesis: Kontinen S., 2000, Tähtienvälisten molekyylien pylvästiheyksien johtaminen radiospek-
triviivahavainnoista, (ecl)

C. Chemistry

Ph. D. in Chemistry 1997-2001

2001

Aurela Birgit	cl	Migration of Substances from Paper and Board Packaging Materials
Jalkanen Liisa	mcl	Atmospheric inorganic trace contaminants in Finland, especially in the Gulf of Finland
Kanniainen Tapio	cl	Studies of Zinc and Lead Chalconide Thin Films Grown by SILAR (Successive Ionic Layer Adsorption and Reaction) Technique
Koivusalmi Eija-Anneli	cl	Characterisation and Analysis of Synthesis Mixtures of Hydroxy Aldehydes, Hydroxy Carboxylic Acids and Polyols
Lehtinen Christel	nsla	Oxidation of Aldehydes:Effects of Structure and Reaction Parameters and Use of Aldehydes in the Epoxidation of Alkenes with O2
Mäkelä Taru	cl	Synthesis of the Mammalian Lignans Enterolactone and Enterodiol and Related Compounds
Nyman Tuula	mcl	Biochemical Characterization and Functional Studies on Human Leukocyte IFN-á Using Mass Spectrometry and Proteome Analysis
Pajo Leena	cl	UO2 Fuel Pellet Impurities, Pellet Surface Roughness and n(18O)/n(16O) Ratios, Applied to Nuclear Forensic Science
Pietikäinen Pekka	ecl	Manganese-Salen Catalyzed Asymmetric Epoxidation: Search for New Oxidation Systems
Salakka Auli	cl	Synthesis of Isoflavonoid Metabolites
Saloniemi Heini	ecl	Electrodeposition of PbS, PbSe and PbTe Thin Films
Straka Michal	mcl	Väitöskirjan nimi: Computational Studies of New Heavy-Element Species
Syrjänen Kaisa	ecl	Oxidative Coupling of Phenols as a Model Reaction for Lignin Biosynthesis
Wallenius Maria	mcl	Origin determination of reactor produced plutonium by mass spectrometric techniques: application to nuclear forensic science and safequards
Walsby Nadia	ecl	Preparation and Characterisation of Radiation-Grafted Membranes for Fuel Cell

2000

Al-Maharik Nawaf	mcl	Synthesis of Isoflavonoid Derivates of Immunoassay
Ennari Jaana	ecl	Atomistic Molecular Modelling of PEO Sulfonic Acid Anion Base Polymer Electrolytes
Helaja Tuulamari	ecl	Synthesis of Functionalised Alkenes and their Interaction with Zirconocene-Methylaluminoxane Catalyst System
Hyvärinen Kristiina	ecl	The Willstätter Allomerisation of Chlorophylls a and b
Koivisto Pertti	ecl	DNA Adducts of the Epoxy Metabolites of 1,3-Butadiene
Laine Timo	mcl	Diimine Complexes of Late Transition Metals as Alkene Polymerization Catalysts
Leivuori Mirja	cl	Distribution and Accumulation of Metals in Sediments of the Northern Baltic Sea
Li Wei-Min	mcl	Characterization and Modification of SrS Based Blue Thin Film Electroluminescent Phosphors
Mäkelä Kari	mcl	Development of Techniques for Electrochemical Studies in Power

		Plant Environments
Paatero Jussi	ecl	Deposition of Chernobyl-derived Transuranium Nuclides and Short-lived Radon-222 Progeny in Finland
Pekka Helaja Juho	ecl	Structural Analysis of Natural Chlorin Derivates Utilizing NMR Spectroscopy and Molecular Modelling
Pelander Anna-Kaisa	mcl	Thin-layer Chromatographic Detection of Cyanobacterial Hepatotoxins
Rasku Sirpa	ecl	Deuteration of Flavonoids
Skrifvars Mikael	mcl	Synthetic Modification and Characterisation of Unsaturated Polyesters

1999

Aseyev Vladimir	ecl	Coil-to-Globule Transition of a Polycation in a Water-Acetone Mixture
Harjunpää Vesa	mcl	Enzymes Hydrolysing Wood Polysaccharides, A Progress Curve Study of Oligosaccharide Hydrolysis by Two Cellobiohydrolases and Three b-Mannaneses
Hartonen Kari	ecl	Supercritical Fluid Extraction and Pressurized Hot Water Extraction – Novel Environmentally Friendly Analytical Techniques. Biological and Environmental Applications
Hietala Sami	ecl	Characterisation of Poly(viylidene fluoride)-graft-Polystyrene Sulfonic Acid Polymer Electrolyte Membranes
Hiltunen Jukka	mcl	Radiolabeling of Benzodiazepine Receptor Ligands with Tritium and Iodine-123 for Medical Applications
Juvonen Marja-Riitta	mcl	Analysis of Gold and Platinum Group Elements in Geological Samples
Karhunen Pirkko	cl	Studies on Synthesis and Reactions of Lignin Model Compounds With Biphenyl, Diaryl Ether and Dibenzooxocin Structures
Leinonen Heikki	cl	Removal of Harmful Metals from Metal Plating Waste Waters Using Selective Ion Exchangers
Lewis Philip	cl	Regioselective Synthesis of Isoflavone-O-Conjugates: O-Glucosides, O-Glucuronides and Fatty Acid Esters
Matikainen Jorma	ecl	Synthesis and Isomerization of Polyunsaturates Fatty Acids and Other Polyenoic Compounds. Application of the Intramolecular Diels-Alder Reaction to the Synthesis of Hexahydroindene Derivates
Näsäkkälä Elina	cl	Introducing Simulation Models into Chemistry Classrooms
Ovaskainen	mcl	The Determination of Minor Isotope Abundances in Naturally Occuring Uranium Materials. The tracing Power of Isotopic Signatures for Uranium
Paronen Mikael	mcl	Modification of Polymer Films by Ionising Radiation in the Preparation of Proton Conductiove Membranes
Valo Kristiina	mcl	Studies on Preparation and Substitution of Yba2Cu4O8
Virtanen Jorma	laud	Superlattice Model for Biomimetic and Biological Membranes
Ämmälahti Erja	mcl	Application of NMR Spectroscopy to Structural Studies of Lignin

1998

Dammert Ritva	mcl	Synthesis and Characterisation of Polystyrenes with Varying Chaon Tacticities
Himberg Kimmo	mcl	Development and Evaluation of Methods for Monitoring Polychlorinated Biphenyls in Food and the Environment
Hyötyläinen Tuulia	laud	On-Line Coupled Reversed Phase Liquid Chromatography-Gas

		Chromatography in the Analysis of Complex Samples
Kankaanpää Harri	mcl	Sedimentation, Distribution, Sources and Properties of Organic Halogen Material in the Gulf of Finland
Ketola Raimo	cl	Method development in Membrane Inlet Mass Spectrometry, Air Analysis and Desoprtion Techniques
Koskinen Jere	mcl	Quantum Chemical, Sturctural and Spectroscopic Studies on Glyoxal Bis(Aminohydrazone) and Selected Structurally related Model Molecules
Lu-Lowe Tao	ecl	Hydrophobically Modified Responsive Polyelectrolytes Base on N-isopropylacrylamide
Mattinen Maija	mcl	Structural and Functional Studies of Fungal Cellulose-Binding Domains by NMR Spectroscopy
Pettersson Mika	ecl	Novel Rare-Gas Chemistry in Low-Temperature Matrices
Pilviö Seija	mcl	Methods for the Determination of Low-level Actinide Concentrations and their Behavior in the Aquatic Environment
Pinnioja Sinikka	mcl	Thermoluminescence Method for Detection of Irradiated Food
Valkonen Mika	cl	Preparation and Characterization of CdS, ZnS Thin Films and CdS/ZnS Multilayer Thin Films Grown by the SILAR Technique
Wiedmer Susanne	ecl	Micellar Electrokinetic Capillary Chromatography with Solutions of Sodium dodecyl Sulfate and Sodium Cholate
Zhu Xinsheng	cl	Modification of Thermal and Thermo-oxidative Degradation of Polystyrene with Acidic Additives

1997

Korhonen Pirjo	lub. a	The Combination of the Ligand Exchange/Template Polymerization Approach for the Resolution of Amino Acid Racemates
Lindroos Seppo	mcl	The Successive Ionic Layer Adsorption and Reaction (SILAR) Growth and Characterization of ZnS and ZnS:Mn Thin Films
Lummila Juha	mcl	High Resolution Vibration-rotation Spectroscopy of Stibine, Deuterated Methyl Fluoride and Iodoacetylene
Pantsar-Kallio Mari	mcl	Development of Speciation Methods for Arsenic, Chromium, Halogenides and Oxyhalogens by Ion Exchange Chromatography-Inductively Coupled Plasma Mass Spectrometry
Polamo Mika	ecl	Aminopyridinato Complexes of Early Transition Metals: Syntheses, Crystal Structures and Utilization as Polymerization Catalysts
Repo Timo	ecl	Studies of Steric Interactions in Metallocene Catalyzed Olefin Polymerization
Tauber Andrei	mcl	Synthesis of Donor-Acceptor Model Compounds, Based on Chlorophyll a Derivates for Implementing Photoinduced Electron Transfer
van Leuken Ronald	cl	Compatibility of Liquid Chromatography and Liquid Chromatography Coupled with Thermospray Mass Spectrometric Detection for Industrial Applications
Vesterinen Elina	ecl	Studies on the Chemical and Stuctural Properties of Thermally Responsive Copolymers and Gels Based on N-isopropyl Acrylamide
Yli-Kauhaluoma Jari	laud	Antibody Catalysis of Some Organic and Biochemical Reactions

M.Sc. Thesis in English 1997-2001

2001

Junkkala Tuulia	ecl	Solid Phase and Solution Phase Synthesis of Imidazole, Imidazoline and Benzimidazole Derivaties as Potential a2 Adrenergic Reseptor

		Ligands
Ristolainen Noora	cl	Chracterization of ABS/PC

2000

Heinänen Maarit	ecl	Analysis of Organic Acids in Urine
Kettunen Mika	ecl	Asymmetric Hydroformylation by Rhodium and Platinum Based Catalysts
Nissinen Terhi	mcl	Corrosion of Steel in Saline Water
Rajamäki Suvi	ecl	Design, Synthesis and Biological Evaluation of New Intercalators with Antitumor Activity
Roozeman Robertus	mcl	Some Aspects of the Mobility of Hydrogen in Solid Xenon Matrices

1999

Kaijalainen, Kari Olavi	mcl	Synthesis of alkyl-substituted thienylene oligomers
Kauppi Salla	cl	Chemically and Enzyme Catalysed Reactions of Aza Thia Tetracyclic Compounds
Korsisaari Niko	mcl	Asymmetric Phase Transfer Reactions
Mäkelä Nora	ecl	Research of Metallocenes and Metallocene Activation- Ultraviolet and Visible Spectroscopy
Nykänen Tiina	nsla	The Cannizzarro Reaction and Polyhydric Alcohols
Sorsa Tarja	mcl	Proteolytic Processing and Dimerization of the VEGF-C Growth Factor
Suurpää Jaakko	mcl	The Synthesis of Trifluoromethyl Phenoxide and Fluorinated Aromatic Compounds via Perfluoroalkylation and the Diels-Alder Reaction
Turtiainen Tuukka	ecl	Radon removal from different types of groundwater applying granular activated carbon filtration
Vilamo Outi	cl	The preparation of ether- and aminopolycarboxylates by O- and N-alkylation

1998

Aremo Nina	ecl	Clay Catalyzed Aldehyde Reactions
Hämäläinen Taina	laud	Some Studies towards a Fully Synthetic Vaccine against Neisseria Meningitidis
Karhu Paula	ecl	The Effects of pH, Organic Matter and Competing Ions on the Migration of Anthropogenic Radionuclides in Soils and Sediments
Kyntäjä Marjo	mcl	Modifying the surface acidity of alumina and silica with Lewis acids and bases
Mansikka Timo	mcl	Synthesis and Characterisation of Thienylene-Vinylene Oligomers
Min Yuan	anal	Determination of cations by CE using indirect UV absorbance and indirect fluorescence detection
Moilanen Juha	mcl	Lubricity Additive from Renewable Resources for Low Lubricity Diesel Fuels
Stenman Annika	mcl	Catalysed Darzens Reactions

1997

Brotherus Robert	ecl	New computational tools for rotational analysis of infrared spectra of linear molecules: Application to the n 4 and n 3 systems of deuterobromoacetylene
Harjunpää Irene	ecl	Recent Developments in Solid Phase Peptide Synthesis
Keller LaDena	mcl	Classification of Alcoholic Beverages by Multivariate Statistical

		Methods
Kärkkäinen Tiina	laud	Studies on Chemoselective Glycosylations: Exploiting Electron Withdrawing Leaving Groups
Shimmo Masahiko	mcl	Technigues for atmospheric nitric acid measurement; intercomparison and application
Virtanen Janne-Juhani	mcl	The Synthesis of Aryl Substituted Oligothiophenes

M. Sc. Thesis in Swedish 1997-2001

2001

Grönholm Marielle	mcl	Derivatiseringsmetoder för gaskromatografisk- masspektrometrisk analys av droger
Juselius Jonas	laud	Ab-initio –beräkning av inducerade ringströmmar I aromatiskamolekyler
Trogen Mikaela	ecl	Kirala selektorer för separation av enantiomerer

2000

Wiik Camilla	mcl	Binukleära manga-redosenzymer och deras syntetiska modeller
Gyllenberg Triin	mcl	Komplex mellan borsyror och socker: stabilitet, struktur, egenskaper och användning

1999

Bäckström Kati	cl	Organiska syror och baser. Teoretiska metoder för att bestämma pK3 –värden
Blomberg Malin	nsla	Atomiserings- och joniseringskällans inverkan på störningar I ICP-AES och ICP-MS analytiken
Gustafsson Marcus	ecl	Semisyntes och totalsyntes av paklitaxel
Järnström, Helena K	cl	Extraktivämnens roll vid framställning och blekning av massa
Karlsson Thomas	mcl	Metoder för stereoselektiv makrolaktonisering vid naturproduktsyntes
Koskela Suvi	mcl	Inverkan av kirala hjälpämnen på stereokemin vid radikalkoppling
Vuori Sanna	cl	Oxazolidinoner vid stereoselektiv syntes

1998

Silfverberg Mikaela	mcl	Framställning och karakterisering av syntetiska ligniner

1997

Wallén Erik	mcl	Rodiumkarbenoidreaktioner som metod för karbocyklisering

D. Computer Science

A selection of Master's, Licentiate and Doctoral Theses 1999-2001

This appendix contains a list of all the Master's Theses written in English (63 theses) and the best one written in Finnish during 1999-2001 (1 graded laudatur out of a total of 109 theses). It also contains a list of all Licentiate (5 theses) and Doctoral Theses (11 theses) during 1999-2001.

Master's Theses

1999

- Kaisu Villa: Replication in a distributed configuration management system. mcl. C-1999-3.
- Markku Laukkanen: CORBA/SNMP based network management. cl. C-1999-6.
- Jahan Noor: Making objects persistent in a CORBA environment. cl. C-1999-7.
- Tony Jokikyyny: Computer supported software inspection process. cl. C-1999-8.
- Tuija Hurtta: The functionality of packet data access node in future wireless packet data networks. ecl. C-1999-11.
- Marko Perttilä: Expected behaviour of TCP and MDCP in GPRS environment. cl. C-1999-15.
- Paulius Meskauskas: Mobile agent-based intelligent network environment. mcl. C-1999-20.
- Marko Jokinen: A communication mechanism for component-based distributed computing. nsla. C-1999-21.
- Henri Sintonen: Business application concepts in WAP-environment. cl. C-1999-27.
- Jarno Tenni: Methods and a tool for controlled language specification. mcl. C-1999-29.
- Antti Hoikkala: Collaborative technologies for virtual workplace. cl. C-1999-33.
- Juha Makkonen: Lifespan of data in a warehouse. ecl. C-1999-38.
- Kimmo Lampinen: Design and implementation of an HTML-based online assistance system. mcl. C-1999-39.
- Antti Mettälä: Component based framework for creating process simulation WWW user interfaces. cl. C-1999-47.
- Arne Dybdahl: Animation with Excel. nsla. C-1999-50.
- Patrik Palm: Iconic indexing of images in PICSearch. mcl. C-1999-54.
- Hu Rui: Performance-oriented software engineering for E-commerce. nsla. C-1999-63.
- Timo Virtanen: Dimensioning GSM data services. cl. C-1999-64.
- Markus Stenberg: Evaluation of communication interfaces for distributed systems. mcl. C-1999-69.
- Martti Söderlund: Protocol testing with TTCN and ASN.1. mcl. C-1999-70.
- Frans Tuomela: Protocols of media gateway controller. ecl. C-1999-71.
- Jukka Manner: TCP over GPRS - performance analysis. ecl. C-1999-72.

2000

- Olli Pihlajamaa: Profiling organisational processes for successful workflow management. mcl. C-2000-10.
- Jan Lindström: Experimental performance evaluation of RODAIN concurrency control and scheduling. ecl. C-2000-13.

- Timo Patrikka: Protocol testing of OSPF in the DX 200 system. cl. C-2000-14.
- Ilkka Autio: Mapping real-world environments with an autonomous robot. ecl. C-2000-17.
- Tero Kauppinen: IP over Bluetooth. ecl. C-2000-20.
- Matti Heikkurinen: Software process development in a medium-sized software project. mcl. C-2000-24.
- Eeva Vuorinen: The impact of XML in e-commerce. mcl. C-2000-27.
- Tero Mäkelä: Charging and billing in GRPS. mcl. C-2000-28.
- Jonne Soininen: Mobile IP in the 3rd generation cellular networks. cl. C-2000-30.
- Jani Månsson: Location-based services in wireless local area networks. mcl. C-2000-34.
- Jussi Vuorento: The effects of power control in bluetooth networks. ecl. C-2000-35.
- Mari Rahkila: Capacity testing of real time database system for telecom use. 3/3. C-2000-37.
- Sami Perttu: Combinatorial pattern matching in musical sequences. l. C-2000-38.
- Rasmus Nybergh: Interconnection networks for DX200. mcl. C-2000-41.
- Vera Izrailit: Optimization of pattern matching expressions in a functional language. cl. C-2000-42.
- Simo Lankinen: Usability criteria of an online software process guide. mcl. C-2000-45.
- Ykä Huhtala: Finding similar time series in a large collection of sequence data. mcl. C-2000-47.
- Henry Freedman: Agent technology in software. cl. C-2000-51.
- Mikko Koivisto: Sukulaisriskien laskenta ja käyttö geneettisten mallien arvioinnissa (Computing and using relative risks in the evaluation of genetic models In Finnish) l C-2000-52.
- Sasu Tarkoma: User dialogue management in the FIPA architecture. mcl. C-2000-56.
- Tommi Martikainen: Quality service in Internet protocol suite for mobile terminals. ecl. C-2000-59.
- Jan Bäckström: Deploying telecommunications services over an IP network. cl. C-2000-62.
- Joanna Uusikartano: Security issues in GPRS legal interception. cl. C-2000-63.
- Jani Boström: Providing value-added services for corporate users in 3G networks. mcl. C-2000-64.
- Andrei Gurtov: TCP performance in the presence of congestion and corruption losses. ecl. C-2000-67.
- Tomi Päiväniemi: Combining inference methods for Bayesian networks. mcl. C-2000-69.

2001

- Panu Kuhlberg: Effect of delays and errors on TCP-based wireless data communication. ecl. C-2001-7.
- Pasi Sarolahti: Performance analysis of TCP enhancements for congested reliable wireless links. ecl. C-2001-8.
- Teemu Head: Techniques for application integration. cl. C-2001-13.
- Toni Poikela: OSA framework implementation in 3G IN. cl. C-2001-18.
- Hui Zheng: Runtime memory usage estimation from UML diagrams. mcl. C-2001-21.
- Jens Hendrén: Software development renewal from customer specific projects to product development. cl. C-2001-22.
- Teemu Tonteri: A statistical modeling approach to location estimation. ecl. C-2001-26.
- Miro Lehtonen: Semi-automatic document assembly with structured source data. ecl. C-2001-30.

- Mia Haarala: Gathering and managing information for centralised user profiles for utilisation in third generation mobile services. cl. C-2001-36.
- Paula Silvonen: Correcting and unifying domain-specific texts. mcl. C-2001-37.
- Janne Teinilä: Performance analysis of a large database in a customer relationship management system. mcl. C-2001-43.
- Mika Pennanen: Agents in virtual home environment. mcl. C-2001-45.
- Liisa Paasiala: Estimating software project effort. ecl. C-2001-46.
- Jaakko Vuolasto: A framework for electronic dictionaries. mcl. C-2001-49.
- Jussi Laukkanen: An evaluation of IPv6 transition mechanisms in implementation of UMTS Internet access. ecl. C-2001-50.
- Jukka Wallenius: Applying neural networks in information retrieval. ecl.
- Anne Vanhala: Prepaid services in GPRS. nsla.

Licentiate Theses

2000

- Matti Luukkainen: Timed semantics of concurrent systems. ecl. C-2000-4.
- Jaakko Kurhila: Individualization by software advisors in computer-supported special education. mcl. C-2000-7.
- Kirsti Äystö: Kolmiulotteisen kappaleen etsiminen tietokannasta tiheysjakauman perusteella. (Searching for three-dimensional objects in databases using density distributions. In Finnish) cl. C-2000-23.

2001

- Jan Lindström: Optimistic concurrency control methods for real-time database systems. mcl. C-2001-9.
- Päivi Hurri: Hypertekstien samankaltaisuuden tunnistaminen (Identifying similar hypertexts. In Finnish.). mcl. C-2001-12.

Doctoral Theses

1999

- Mika Klemettinen: A knowledge discovery methodology for telecommunication network alarm databases. mcl. A-1999-1.
- Juha Puustjärvi: Transactional workflows. mcl. A-1999-2.
- Juha Kärkkäinen: Repetition-based text indexes. ecl. A-1999-4.

2000

- Pirjo Moen: Attribute, event sequence, and event type similarity notions for data mining. mcl. A-2000-1.
- Barbara Heikkinen: Generalization of document structures and document assembly. mcl. A-2000-2.
- Pekka Kähkipuro: Performance modeling framework for CORBA based distributed systems. ecl. A-2000-3.
- Kjell Lemström: String matching techniques for music retrieval. mcl. A-2000-4.

- Timo Karvi: Partially defined Lotos specifications and their refinement relations. mcl. A-2000-5.

2001

- Juho Rousu: Efficient range partitioning in classification learning. mcl. A-2001-1.
- Kimmo Fredriksson: Rotation invariant template matching. In press.
- Marko Salmenkivi: Computational methods for intensity models. In press.

Grading

L	Laudatur
Ecl	Eximia cum laude approbatur
Mcl	Magna cum laude approbatur
Cl	Cum laude approbatur
Nsla	Non sine cum laude approbatur
A	Approbatur

Appendix 3 Degrees

Degrees achieved in 1999

	PhD	PhLic	MSc	BSc
Physics	**15**	**14**	**41**	**37**
Physics (including teacher's sp)	12	11	28	24
Theoretical Physics	3	3	13	13
Geophysics	**0**	**3**	**4**	**4**
Meteorology	**1**	**1**	**6**	**4**
Astronomy	**2**	**1**	**4**	**3**
Chemistry	**16**	**12**	**76**	**75**
Analytical Chemistry	1	3	17	
Inorganic Chemistry	3		14	
Physical Chemistry	1	1	1	
Organic Chemistry	5	3	30	
Polymer Chemistry	3	3	8	
Radiochemistry	3	2	6	
Mathematics	**2**	**4**	**45**	**45**
Computer Science	**3**	**2**	**55**	**62**

Degrees achieved in 2000

	PhD	PhLic	MSc	BSc
Physics	**14**	**13**	**48**	**39**
Physics (including teacher's sp)	12	11	33	25
Theoretical Physics	2	2	15	14
Geophysics	**6**	**4**	**3**	**2**
Meteorology	**0**	**1**	**2**	**4**
Astronomy	**1**	**1**	**0**	**0**
Chemistry	**14**	**21**	**54**	**52**
Analytical Chemistry	2	5	14	
Inorganic Chemistry	3	4	9	
Physical Chemistry		2	2	
Organic Chemistry	6	6	16	
Polymer Chemistry	2	2	6	
Radiochemsitry	1	2	7	
Mathematics	**1**	**4**	**46**	**46**
Computer Science	**4**	**5**	**64**	**72**
Degrees achieved in 2001 (untill 16.11.2001)				
	PhD	**PhLic**	**MSc**	**BSc**
Physics	**15**	**14**	**43**	**35**
Physics (including teacher's sp)	5	7	25	18
Theoretical Physics	6	3	11	10
Geophysics	0	1	2	2
Meteorology	3	2	4	4
Astronomy	1	1	1	1
Chemistry	**12**	**11**	**48**	**36**
Analytical Chemistry	1	2	15	
Inorganic Chemistry	2	1	8	
Physical Chemistry	2		5	
Organic Chemistry	4	3	13	
Polymer Chemistry	1	3	4	
Radiochemistry	2	2	3	
Mathematics	**2**	**9**	**20**	**17**
Computer Science	**2**	**3**	**50**	**59**