Biomedical Engineering Education in Finland

Jari Viik
Finnish Society for Medical Physics and Medical Engineering
P.O. Box 110
33721 Tampere, Finland
jari.viik@tut.fi

Jari Hyttinen
Tampere University of Technology

Juha Nousiainen
Tampere University of Technology

Jukka Nenonen
Helsinki University of Technology

Timo Jämsä
University of Oulu

Jukka S. Jurvelin
University of Kuopio

Pekka Hänninen
University of Turku

Maunu Pitkänen
Association of Hospital Physicist

The updated version of this report is available on Internet, www.ee.tut.fi/~lfty/

From a broad perspective, Biomedical Engineering (BME) embraces the utilization of all technical disciplines in Medicine. In Finland, research and education have, however, primarily concentrated on the application of expertise in Electronics, Computer Science and Physics. The industry is primarily located in the proximity of university hospitals and universities. Industrial growth as well as the increase in personnel in the field of BME has been rapid and substantial.

In Finland, BME education with broader curricula in BME was launched by Tampere University of Technology (TUT) at the beginning of the 1970's. There is no accreditation for BME degrees and study programs, with the exception of hospital physicists (see chapter Hospital Physicists Education). Along with the growth in the field, the need for education in BME has also increased in recent years. Consequently, curricula including BME have been set up at many universities. In addition to TUT, education is at present provided by Helsinki University of Technology and the Universities of Kuopio, Oulu and Turku. Furthermore, several courses on BME are lectured at other Finnish universities. Table 1. presents the number of teachers and Master of Science (M.Sc.) degrees per year (situation at 2001) in the field of BME at each university.

The M.Sc. degree requires studies of 160 credits and M.Sc. in Technology requires 180 credits. Both degrees include a 20-credit thesis. The Bachelor of Science (B.Sc.) degree requires studies of 120 credits. It is possible to receive a B.Sc. degree in universities. In the curriculum for the M.Sc. in Technology, it is possible to apply for the certificate of B.Sc. degree when the student has completed at least 120 credits. One Finnish credit represents approximately 40 hours e.g. a week's workload for an individual student. Thus one Finnish credit corresponds to 1.5 European Credit Transfer System (ECTS) credits.

Table 1. The number of teachers related to BME and the annual number of M.Sc. degrees (year 2001) in the field of BME at Finnish universities, which provide BME education.

University	Professors	Assistant professors	Assistants	M.Sc. degrees
Tampere University of Technology	6	2	1	22
Helsinki University of Technology	4	1	1	15
University of Oulu	3	3	3	20
University of Kuopio	6	3	2	15
University of Turku	2	1	3	-

BME, Biomedical Engineering; M.Sc., Master of Science.

Survey of Persons Having Studied BME at the TUT www.ee.tut.fi/rgi/bme-survey

Jari Viik and Jaakko Malmivuo have made a survey to investigate the placement in working life of the biomedical engineers who have studied BME in the Ragnar Granit Institute (RGI) at TUT (*Biomedical Engineering as a Career Resource: Placement in working life of Masters of Science in Engineering who have studied Biomedical Engineering at Tampere University of Technology, ISBN 952-15-0047-6*). The material of the survey consisted of 267 persons who had included BME as a major or minor subject in their M.Sc. degree program between 1976 and the spring of 1997. The study was conducted during the summer of 1997 as a postal questionnaire study. In addition to the questionnaire study, a survey was also conducted concerning the study history of all Masters of Science in Engineering who had studied BME as their major or minor subject. The complete report is available on the Internet, http://www.ee.tut.fi/rgi/bme-survey/. The main results of the survey have also been published in the International Journal of Engineering Education 1999:15:308-320.

National Society www.ee.tut.fi/~lfty

The Finnish Society for Medical Physics and Medical Engineering (formerly the Finnish Society for Biological and Medical Engineering) was founded in March 1968. According to its bylaws the purpose of the Society is "to raise and to maintain interest in medical physics, biomedical engineering and biophysics and to promote the development of these disciplines in the field of scientific research, education and practice". The Society has been affiliated with the International Federation for Medical and Biological Engineering (IFMBE) in 1969 and with the International Organization for Medical Physics (IOMP) in 1973.

The aim of the Finnish Society during its whole history has been the establishment and promotion of the international contacts. The Finnish Society arranged the First Nordic Meeting on Medical and Biological Engineering in Espoo in 1970. The Third Nordic Meeting was also arranged in Finland, this time in Tampere in 1975, the 6th in Helsinki in 1985 and the 10th in Tampere in 1996. The 10th meeting was extended to cover the whole Baltic region and its name was changed to Nordic-Baltic Conference on Biomedical Engineering. The largest and most challenging event organized by the Finnish Society has been the XIV International Conference on Medical and Biological Engineering and VII International Conference on Medical Physics held in Espoo in 1985.

At the time of the foundation of our Society medical physics and engineering education was completely missing. After the foundation, the Society arranged courses on basic education. The activities of the Society in the continuing education of the hospital physicists and biomedical engineers began in 1978, when the society arranged the first course on biomedical engineering. After that, the Society has arranged more than 20 courses on several topics. They have dealt with bioelectricity, biosystems, data processing, devices and methods in radiotherapy, digital image processing in medicine, picture archiving and communication systems in medicine, the safety of medical equipment as well as magnetic resonance imaging. These events have been very important for training medical physicists, physicians and engineers.

In 1979 the society started the Progress Report symposium and contest for young scientists. This competition was arranged annually until 1989, when it was discontinued. The Finnish Society launched a new meeting series during the 2002 Medical Physics and Medical Engineering Day. The main purpose of these events is to present the latest Master's theses in the field of medical physics and engineering by poster competition and to improve the education and research co-operation between different centers in Finland. In addition to the presentation of theses, the organizing university presents its education and research in the field of BME and BME companies have the opportunity for exhibition and recruiting. The First Medical Physics and Medical Engineering Day was arranged at TUT. For postgraduate students the Finnish Society established a poster exhibition and competition together with the Finnish Physical Society's Biological and Medical Physics Division in 2002. This event took place as a part of the 'Physics Days' (annual national symposium) arranged by the Finnish Physical Society and is planned to be arranged during the 'Physics Days' in future.

TAMPERE UNIVERSITY OF TECHNOLOGY www.tut.fi

Tampere University of Technology (TUT) is the second largest technical university in Finland with about 10 000 students and 14 degree programs.
Course studies on BME started already in the early 1970s. Since then, the curriculum has been extended and several aspects of biomedical engineering are now covered. Education in BME is provided by the Ragnar Granit Institute (RGI), the Institute of Signal Processing, and the Institute of Biomaterials. Until 2001, almost 200 students have graduated with BME as their major subject.

Biomedical Engineering and Medical Informatics www.ee.tut.fi/rgi

A comprehensive study course in biomedical engineering and medical informatics is available. This block of studies is offered within the degree program of electrical engineering and it is intended for graduate students in electrical engineering and information technology. The program is provided by the Ragnar Granit Institute and organized partially in co-operation with the Institute of Signal Processing of TUT (sigwww.cs.tut.fi/).

The aim of the study program is to provide students with an excellent ability to apply their skills in electronics and computer science in the field of medicine. Special emphasis is placed on bioelectric and biomagnetic phenomena, modeling methods and modern physiological signal and medical image processing. Education includes courses in medical electronics, medical physics and medical informatics as well as practical laboratory exercises. In addition to the subjects of biomedical engineering, the program deals with electronics and computer science. Thus the acquired knowledge can also be applied to the wider field of electronics and information technology in trade and industry.

The priority fields of the research education provided by the Institute, aiming at a postgraduate degree, include Bioelectromagnetism and Multimodal Processing of Medical Images and Medical Informatics. Due to the internationalization development, English has established itself as the primary teaching language at the Institute, although all the compulsory courses are also given in the Finnish language.

A Graduate BME studies

Study Program

The most extensive way to study BME is provided by the study program in BME. This program is part of the degree program in electrical engineering, including 36-45 credits (54-67.5 ECTS credits) of courses in BME. It can be joined by students in electrical engineering as early as in the beginning of their second year when part of the common program studies include some basic subjects in BME, replacing courses in electrical engineering. After completing the common program studies students take BME as their major subject.

BME as a Major Subject

BME as a major subject is allowed for students in electrical engineering and information technology degree programs. The major subject in BME contains course studies of at least 30 credits (45 ECTS credits). Between two alternatives can be chosen: medical electronics and medical informatics.

BME as a Minor Subject

BME as a minor subject is worth at least 15 credits (22.5 ECTS credits) and it is elective for students in several degree programs.

B Postgraduate Studies on BME

The postgraduate program in BME focuses on bioelectromagnetism – study of bioelectric and biomagnetic phenomena of living tissue, modeling and analysis of physiological signal and medical images as well as neuroinformatics. The framework for the doctoral studies is formed by doctoral seminars, postgraduate courses, and other scientific seminars and meetings.

In the Doctoral Program, Licentiate of Technology (Lic.Tech.) and Doctor of Technology/Philosophy (Dr.Tech./Ph.D.) degrees can be pursued. Doctoral study is performed in the field of bioelectromagnetism or biomedical engineering. It consists of a Major Subject in Biomedical Engineering (worth 30 credits), supporting studies (worth 15 credits) and the doctoral thesis

C Course Syllabus

Students in the electrical engineering degree program include the two courses Human Anatomy and Physiology and Introduction to the Small-Signal Instrumentation into their common program studies. In addition to these classes, basic courses in electronics, electromagnetism, and computer science are taken.

Medical Electronics

In medical electronics the emphasis is on special issues and requirements of the design of medical electronic instrumentation. Thus the students are well prepared to work in different functions in medical electronics and IT industry. The alternative contains special courses in medical electronics, instrumentation in clinical chemistry and medical physics.

Students with a major subject in medical electronics can take their minor subject in electronics, digital signal processing, measurement technology, digital and computer technology, technical physics and mathematics, industrial management and biomaterial science.

Medical Informatics

Medical informatics covers various aspects of application of information technology in medicine and health care. The studies in medical informatics are supported by several special courses in information technology provided by the Institutes of Software Engineering, Signal Processing, Digital and Computer Technology, Telecommunication, and Mathematics. The minor subject can be chosen from these fields.

In addition to the theoretical courses the syllabus of medical electronics and informatics includes several practical courses, which are obligatory in the major subject. To support the two major subject alternatives the BME syllabus provides some advanced courses in the field of bioelectromagnetism.

Common program studies	*CU*	
Human Anatomy and Physiology	4	
Introduction to the Small-Signal Instrumentation	2	
Courses in medical electronics		
Biomedical Engineering	3	
Medical Electronics	3	
Medical Device Regulations	2	
Instrumentation in Clinical Chemistry	2	
Biosensor Technology	3	P
Radiotherapy Devices	2	
Medical Imaging Methods	4	

Radiation and Safety	2	
Courses in medical informatics		
Introduction to Medical Informatics	4	
Processing of Physiological Signals	3	
Processing of Medical Images	3	P
Introduction to Telemedicine	2	
Practical courses		
Biomedical Engineering Laboratory Course I	2	
Medical Electronics Laboratory	2	
Medical Informatics Laboratory	2	
Biomedical Engineering Project	3	
Biomedical Engineering Thesis Seminar	1	
Advanced courses		
Bioelectromagnetism	5	P
Modeling of Physiological Systems	3	P
Neuroinformatics	3	P
Doctoral Seminar on Biomedical Engineering	4-8	P

The courses marked with 'P' are accepted for postgraduate studies. One CU corresponds to 1.5 ECTS credits.

Biomaterial Science www.tut.fi/units/ms/biom

The Institute of Biomaterials is one of the leading European research centers in materials technology of bioabsorbable polymers, composites and surgical implants manufactured from them.

The teaching program of the institute is located under the Materials Department and teaching is focused on medical biomaterials and tissue engineering but one course is given on compostable biomaterials. The courses are given in the Finnish language but for some courses material is available in English.

A Graduate Studies

Study Program

Students have an opportunity to study Biomaterials as a major subject and as a minor subject. Recommended minor subjects along with Biomaterials are for example fiber technology, chemistry, safety studies, BME and medical studies.

Biomaterials as a Major Subject

The major subject in Biomaterials contains course studies of at least 30 credits (45 ECTS credits). Biomaterials as a major subject is allowed for students in materials science degree programs.

Biomaterials as a Minor Subject

Biomaterials as a minor subject is worth at least 15 credits (22.5 ECTS credits) and it is elective for students in several degree programs.

B Postgraduate Studies

The postgraduate program in biomaterials can focus on either medical biomaterials, environmental (compostable) biomaterials or other bulk applications. The framework for the doctoral studies is formed by doctoral seminars, postgraduate courses, and other scientific seminars and meetings.

In the Doctoral Program, Licentiate of Technology and Doctor of Science degrees can be pursued. Studies consist of a Major Subject in Biomaterials and supporting studies, together the equivalent of 45 credits, and a written thesis.

C Study Courses

Intermediate courses	*CU*	
Introduction to Medical Biomaterials	2	
Tissue Engineering I	2	
Compostable Biomaterials	2	
Advanced courses		
Applications of Medical Biomaterials	2	
Tissue Engineering II	2	P
Implant Technology	3	P
Thesis Seminar in Biomaterials	1	
Special Treatise on Biomaterials Science	3	

The courses marked with 'P' are accepted for postgraduate studies. One CU corresponds to 1.5 ECTS credits.

Biotechnology Program at the University of Tampere www.uta.fi/imt/

In addition to the curriculum in TUT, the University of Tampere has a new program for a Master of Sciences degree in Biotechnology coordinated by Institute of Medical Technology (IMT). The program started in 2001 and 15 students started in the Master of Sciences curriculum and seven students in the diplom engineer (M.Sc. in Technology) curriculum. The program provides a novel type of training with special emphasis on modern biomedical research and biotechnology, and it is jointly run by IMT, TUT and the Medical School of the University of Tampere. Courses related to BME are given by TUT's departments.

HELSINKI UNIVERSITY OF TECHNOLOGY www.hut.fi

Biomedical Engineering and Living State Physics www.hut.fi/Units/Biomedical

Helsinki University of Technology (HUT) is the leading technical university in Finland with 12 departments. The laboratory of Biomedical Engineering (established in 1988) operates in the Department of Engineering Physics and Mathematics.
It promotes both basic and graduate education as well as research in the fields of biomedical engineering and biophysics. The Laboratory also coordinates a national Graduate School "Functional Research in Medicine", http://futu.hut.fi.
In addition, some courses on BME are given by the Laboratory of Applied Electronics at the Department of Electrical and Communications Engineering.

A Graduate BME Studies

BME can be studied for a Master of Science in Technology degree (M.Sc. Tech.) in the Program of Engineering Physics. BME can be chosen as a major or minor.
The instruction of the degree programs is organized in such a manner that it is possible for a student to acquire approximately 35 credits (52.5 ECTS credits) in one academic year and graduate in five years.

B Postgraduate Studies in BME

Postgraduate degrees at HUT, Licentiate and Doctor of Technology (Lic.Tech. and Dr.Tech., respectively), are intended for graduates with a Master's degree. These degrees require examinations in at least two subjects, one of which must be the major. Postgraduate research within the major is mandatory. Completion of the Licentiate's degree takes 2-3 years, while a Doctorate requires an additional 1-3 years.
The Graduate School "Functional Research in Medicine" is funded by the Ministry of Education and the Academy of Finland. Besides HUT, the Universities of Kuopio, Oulu and Turku are participating in the Graduate School. It offers a high-level research environment, excellent facilities for its graduate students to work at the front end of research, supports research work aiming at doctoral dissertations, and promotes clinical and technological applications of biomedical engineering and physics. It also arranges new courses on current topics that present the state-of-the art knowledge in the fields of interest in the Graduate School.

C Study Courses

General physics courses	*CU*	
Modern Physics I	4	
Modern Physics II	4	
Classical Theory of Electricity and Magnetism	5	
Applied Physics, Laboratory Course	2	
Courses on biomedical engineering and living state physics		
Introduction to Living State Physics	2	
Biophysics	3	
Medical Physics I	3	
Medical Physics II	3	
Seminar on Biomedical Engineering	2	
Biophysics and Biomedical Engineering, special assignment	5	
Electrophysiology	3	P

Structure and Function of the Human Brain	3	P
Signal Processing in Biomedical Engineering	3	P
Image Processing in Biomedical Engineering	3	P
Functional Imaging in Biomedical Engineering	2	P
Medical Imaging Methods	3	P
Functional Macromolecules	3	P
Special Courses on Biomedical Engineering	3	P
Inverse Problems in Biomedical Engineering (1998)		
Molecular Biophysics and Genetics (1999)		
Medical Imaging – Theory and Practice (2000)		
Functional Imaging and Modeling of the Heart (2001)		
Research Seminar on Biomedical Engineering	2	P
Individual Studies	1-10	P

The courses marked with 'P' are accepted for postgraduate studies. One CU corresponds to 1.5 ECTS credits.

UNIVERSITY OF OULU www.oulu.fi

Biomedical Engineering Program

The University of Oulu is a multidisciplinary university with six faculties, including Medicine, Technology, Economics, and Science. The Biomedical Engineering Program was founded in 1994 to promote collaboration in education and research between the faculties.

A Graduate BME Studies

Today, BME can be studied for a Master's degree in three faculties, Science, Technology and Medicine. The courses are taught in collaboration, and the BME students have studies in all three faculties. The combination of courses depends on the program, giving different profiles to the studies.

B Postgraduate Studies in BME

Postgraduate studies can be performed at all three faculties for the degrees of Licentiate and Doctor of Philosophy / Technology (Lic.Phil./Lic.Tech. and Ph.D./Dr.Tech., respectively). The studies are arranged in close collaboration between the faculties. The graduate study courses in BME are also given at the national level.

Faculty of Science / Biophysics physics.oulu.fi/biofysiikka

Biophysics is one of the four divisions of the Department of Physical Sciences. The curriculum in biophysics includes approximately 80 credits (120 ECTS credits) of courses on biophysics. There are two alternative branches of study in which the degree can be taken: Cellular and Molecular Biophysics or Biophysics in BME.

C Study Courses

Basic courses	*CU*
Radiation Physics	1
Introduction to Biophysics	3
Intermediate courses	
Laboratory Exercises in Biophysics I	2
Laboratory Exercises in Biophysics II	2
Analysis of Biosystems	2
Techniques of Medical Devices	2
Project and Seminar	5
Introduction to Project Work	1
Biophysics of Membranes	3
Spectroscopic Methods	2
Advanced courses	
Bioelectronics	2
Laboratory Exercises in Biophysics III	3
Research Project in Biophysics	6
Dynamics of Bioprocesses	2
Simulation of Biosystems	2
Processes of the Nervous System	2
Intracellular Registrations	2

Identification of Linear and Nonlinear Systems	4
Medical Physics	2
Patch-Clamp Techniques	2
Basics of Research	3
Virtual Measurement Environments	3
Special Advance Course	2-6

One CU corresponds to 1.5 ECTS credits.

Faculty of Technology / Engineering programs (BME) www.ttk.oulu.fi

Specialization in BME in the following programs: Program in Electrical Engineering (BME/EE), Program in Information Engineering (BME/IE), and Program in Mechanical Engineering (BME/ME). The curriculum includes 10-30 credits (15-45 ECTS credits) of courses on BME.

C Study courses

Common program studies in BME/EE	*CU*
Basic Anatomy and Physiology	4
Biomedical Measurements	3
Studies of choice in BME/EE	
Product Responsibility and Safety of Medical Devices	1
Medical Imaging	3
BME Project	5
Medical Equipment Design	3,5
Biomedical Engineering in Clinical Medicine	4
Radiation Physics, Biology and Safety	2
Techniques of Medical Devices	2
Spectroscopic Methods	2
Processes of the Nervous System	2
Common program studies in BME/IE	
Basic Anatomy and Physiology	4
Biomedical Engineering in Clinical Medicine	4
Studies of choice in BME/IE	
Telemedicine	3
Biomedical Measurements	3
Medical Imaging	3
BME Project	5
Laboratory Exercises in Biophysics I	2
Medical Physics	2
Introduction to Biophysics	3
Analysis of Biosystems	2
Virtual Reality Techniques	3
Common program studies in BME/ME	
Medical Equipment Design	3,5
Studies of choice in BME/ME	
Biomedical Engineering in Clinical Medicine	4
Biomedical Measurements	3
Product Responsibility and Safety of Medical Devices	1
Medical Imaging	3

One CU corresponds to 1.5 ECTS credits.

Faculty of Medicine / Medical and Wellness Technology www.medicine.oulu.fi/ltek/

The new program in Medical and Wellness Technology was started in 2001. The program is placed in the Faculty of Medicine. The curriculum includes approximately 20 credits (30 ECTS credits) of courses on medicine, 40 credits on BME and 20 on the specialization choice. There are two alternative specialization choices of study: Medical Engineering and Biomedical Technology.

C Study Courses

Common program studies	*CU*
Introduction to Medical Engineering	1
Biomedical Engineering in Clinical Medicine	4
Biomedical Measurements	3
Medical Physics and Imaging Methods	2
Introduction to Biophysics	3
Bioelectronics	3
Analysis of Biosystems	2
Radiation Physics, Biology and Safety	2
Basics in Biomechanics	1
Rehabilitation and Gerontotechnology	1
Techniques in Clinical Chemistry	2
Virtual Measurement Environments	3
BME Programming Study	3
BME Project	5
Medical Physics and Biomedical Engineering Seminar	2
Specialization in Medical Engineering	
Applied Diagnostic Radiology	2
Telemedicine	3
Applied Biomechanics	2
Ergonomics	2,5
Medical Device Technology	2
Product Responsibility and Safety of Medical Devices	1
Introduction to Health Economics	3
Specialization in Biomedical Technology	
Laboratory Exercises in Biophysics I	2
Spectroscopic Methods	2
Biophysics of Membranes	3
Processes of the Nervous System	2
Dynamics of Bioprocesses	2
Basics in Biomaterials	1
Imaging Methods in Biomedical Research	1
Experimental Animal Course	2

One CU corresponds to 1.5 ECTS credits.

UNIVERSITY OF KUOPIO www.uku.fi

Biomedical Engineering venda.uku.fi

The University of Kuopio has a clear profile: it is a university specializing in health-based and environmental sciences including the technologies related to these disciplines. It has five faculties: Business and Information Technology, Medicine, Natural and Environmental Sciences, Pharmacy and Social Sciences. In addition there is the A.I.V. Institute for molecular sciences. Education in the field of BME is closely linked to the university research profile, hospital physicists' education and local health care industry. BME education is arranged at the Faculty of Natural and Environmental Sciences.

A Graduate Study Programs

Medical Physics

The Department of Applied Physics at the Faculty of Natural and Environmental Sciences is responsible for the education in Medical Physics, that is one of the specialization choices in the graduate program of physics. This education has a strong emphasis on mathematical analysis and modeling.

Health Care Technology

The education program of Health Care Technology is part of the education supply available in Centek – a shared education and research development project of the University of Kuopio and Pohjois-Savo Polytechnic. Education in Health Care Technology is planned for students who already have a B.Sc. degree or proper professional education. The duration of the study program is three years. The courses are partially the same as in the education in Medical Physics and are listed below. The wide option to choose courses is characteristic for this program, giving a different, individual study profile to the students. As compared to medical physics education the emphasis is more on teaching the practical and experimental skills

B Postgraduate Studies in Medical Physics

Postgraduate studies in Medical Physics can be performed at the Faculty of Natural and Environmental Sciences for the degrees of Licentiate and Doctor of Philosophy (Lic.Phil. and Ph.D., respectively). The postgraduate program as part of the education of the hospital physicists can be conducted in the university.

C Study Courses

Basic courses	*CU*
Medical Instrumentation	2
Dosimetry in Radiotherapy	2
Physics of Electronic Components	3
Digital Image Processing 1	1
Digital Image Processing 2	1
Advanced courses	
Physics in Clinical Physiology	2
Medical Imaging	2
Magnetic Resonance Imaging	2
Methods and Techniques in Radiotherapy	2
Ultrasound Techniques in Medicine	2

Isotopic Techniques	2	P
Special Course in Medical Physics	1-3	
Materials Science	4	
Biomaterials	3	P
Physics of Medical Implants	2	P
Methods of Materials Analysis	3	
Vacuum Techniques	3	
Medical Signal Analysis	2	
Pattern Recognition and Image Analysis	3	
Time Series Analysis	3	P
Finite Element Methods	3	P
Data-Analysis	3	P
Inverse Problems 1	3	P
Inverse Problems 2	3	P
Information Management in Health Care	3	
Data Protection and Security	3	
Communication, Networking and Internet in Health Care	2	
Information Systems in Health Care	6	
Telemedicine	2	

The courses marked with 'P' are accepted for postgraduate studies. One CU corresponds to 1.5 ECTS credits.

UNIVERSITY OF TURKU www.utu.fi

Biomedical Engineering www.lfy.utu.fi

The Department of Medical Physics was founded in 1992 as part of the Institute of Biomedicine, Faculty of Medicine. The department gives basic education in physics, medical physics and biomaterials to the students in medicine and health biosciences. The department is actively promoting studies at the graduate level through several graduate schools and is offering positions for graduate students either via direct funding from the graduate schools or via industrial funding. The research areas of the department are new bioanalytical methods, light microscopy and biomaterials science.

A Graduate BME Studies

The department of Medical Physics does not offer graduate courses and teaching in BME. However, students of physics at the University of Turku may join the BME program of Tampere University of Technology after completing their basic studies in Physics according to the agreement between the two universities.

B Postgraduate Studies in BME

Postgraduate studies at the department of Medical Physics are organized in national graduate schools in collaboration with other groups within the field. Training is multidisciplinary and Ph.D. degrees may be pursued in fields of biomedical physics and engineering, chemistry and biochemistry. The graduate schools where the students may join through the department are:

- Graduate School of Functional Research in Medicine (FUTU), http://futu.hut.fi/
- Graduate School of Chemical Sensors and Microanalytical Systems (CHEMSEM), http://www.chemsem.hut.fi/
- National Graduate School of Informational and Structural Biology (ISB), http://www.abo.fi/isb/

Graduate courses are organized within the graduate schools and vary from year to year depending on the requests and requirements of the students.

Hospital Physicists Education in Finland www.tek.fi/sairaalafyysikot/

In the field of BME the position of hospital physicist is the only profession which has an accreditation in Finland. According to the Finnish law for professions in health care the title of hospital physicist (sairaalafyysikko) is protected. It means that title can be used only if a person has the formal (registered) qualification in hospital physics. To implement the EC-directive 97/43/Euratom (MED) into Finnish legislation a new statute by the Social and Health Ministry was passed. In that law a formal qualification (registered hospital physicist) is required to be able to practice in radiotherapy and nuclear medicine. The program for the education of hospital physicists is considered an official postgraduate university education.

The Education Committee for hospital physicists co-ordinates the education in the whole country. In the Education Committee, there should be a representative from each university, from the Association of Hospital Physicist and a physician member. The Committee is circulating in different universities at a period of three years. At the moment (for years 2001-2003) the Committee has been nominated by the University of Oulu, Medical Faculty. The rules and functions of the Education Committee have been ratified by each university.

Aims of the Education

The aims of the education of hospital physicists is to give them the skills to work independently in the following commissions in health care:

- to develop diagnostic and therapeutic methods and to participate in diagnostic and treatment procedures
- to perform and supervise physical quality assurance actions
- to perform commissioning of medical devices and software
- to teach in medical physics
- to be responsible for radiation safety
- to support and apply information technology
- to have the ability to carry out scientific research in medical physics and to take part in medical research projects.

Requirements of the Education Program

It is possible to start the education program after the B.Sc. degree. The main subject may be physics, electrical engineering or information technology; physics always has to be included into the degree.

Content of the Education

The education consists of theoretical studies in universities and of practical training in the hospital (some part may be in medical physics research laboratories, as well). In every training center there is an appointed and registered supervisor (professor or head physicist) who is responsible for the execution of the education program.

Basic structure

- a postgraduate studies (at least 40 credit units) in physics or engineering (theoretical education)
- a postgraduate thesis (licentiate or doctoral)
- four years of practical training in five special areas of hospital physics
- radiation safety examination
- final examination considering the application for medical physics in the hospital environment

Theoretical Education

The responsible supervisor will plan the program for the studies to obtain the qualification in medical physics with the student. According to the new statute (834/2000) the student has to pass at least the licentiate of philosophy degree; in many cases students will pass the doctoral degree directly. The main subject of the examination shall be physics, medical physics, technical physics, biophysics or biomedical engineering.

Practical Training

It is possible to start practical training after the B.Sc. degree. Total training time is four years; time from last eight years (from acceptance of the program) has been accepted for training. The training is done in centers which have been accepted by the Education Committee. The training centers have been classified into three categories:

- four years of training time (full rights) possible in all university hospitals
- two years of training time (partial rights):
  in central hospitals where a qualified hospital physicist (registered) is the responsible supervisor,
  in other hospitals/institutes that have been inspected by the Education Committee, have a qualified hospital physicist on their staff and represent four main areas of hospital physics.
- one year of training time (partial rights):
  in medical physics research centers with a qualified hospital physicist available as a supervisor that have been accepted by the Education Committee.

Thus at least three years of the training time must be carried out in a hospital. The supervisor is responsible for the student having work experience in all the main areas of hospital physics: nuclear medicine, clinical physiology, clinical neurophysiology, radiotherapy and oncology, as well as diagnostic radiology. Training will include at least 20 hours of administrative education in hospitals.

Radiation Safety Examination

Some universities have a permission to organize radiation safety examinations at different levels. The permission is granted by the Finnish Radiation and Nuclear Safety Authority. The students have to pass the examination on the level: “the general use of ionizing radiation”.

Final Examination

The aim of the final examination is to test the student's ability to apply the theoretical knowledge to the clinical practice. The examinations are arranged four times per year at the same time as examinations of specializing physicians in medical faculties. The final examination can be taken after three years of practical training and a passed radiation safety examination. The permission to take the examination has to be granted by the Education Committee. Because the postgraduate degree requires at least 40 credit units (60 ECTS credits), the final examination is only testing the ability to apply the theoretical knowledge to the hospital environment.

Qualified Hospital Physicist

If all the parts of the education scheme have been passed it is possible to apply for registration (the status of the title protected hospital physicist) from the National Board of Medicolegal Affairs.

The program meets the educational requirements for national registration schemes for medical physicists recommended by the European Federation of Organizations for Medical Physics.