Opasraportti

FMed - Biomedical Engineering (2017 - 2018)

Master of Health Sciences (MHSc) – Master Programme in Biomedical Engineering

Studies include compulsory intermediate and advanced studies, advanced module's studies and optional studies. The student executes compulsory studies 50 ECTS credits, studies of chosen advanced module 30 ECTS credits, master's thesis 30 ECTS credits, and optional studies so that the total extent of the degree is at least 120 ECTS credits. Studies are executed according to the personal study plan with individual timetable depending on the optional studies. Some of the courses are held only every second year.

Advanced Studies 30 ECTS Credits

There are three specialization choices for advanced studies of which the student selects one. Project work is compulsory part of biomedical engineering advanced studies.

Biomedical Technology: prepares for problem solving in biomedical research, familiarizes with tissue characterization with various research methods, deepens understanding on tissue structure and function in multiple hierarchical levels.

Medical Imaging: prepares for problem solving in medical imaging, familiarizes with medical image processing and analysis, deepens understanding on body structure and function.

Health Technology: prepares for problem solving in health technology applications (health promotion, disease maintenance, gerontechnology), familiarizes with measurement and analysis of health and physical activity, deepens understanding on body function and health promotion.

Optional Studies about 10 ECTS Credits

Optional studies will be executed so that the total extent of the degree is at least 120 Credits. Optional studies can be chosen from other advanced module or from other intermediate and advanced studies that support the degree. In the case of optional studies, if necessary, the student must agree with the organizing department for the participation for the course.

Recommended optional studies:

080923S Physics in Radiation Therapy 5 ECTS cr (P4)

747604S Introduction to Biocomputing 3 ECTS cr (P2)

764322A Cell Membrane Biophysics 7 ECTS cr (P1-P2)

764629S Identification of Linear Systems 5 ECTS (P3)

031044A Mathematical Methods 3 ECTS cr (P1-P3)

464085A Patenting 5 ECTS cr (P3-P4)

812671S Usability Testing 5 ECTS cr (P3-P4)

521238S Optoelectronic Measurements 5 ECTS cr (P4)

521412A Digital Techniques I 5 ECTS cr (P1-P2)

521432A Electronics Design I 5 ECTS cr (P1-P2)

555242A Product Development 5 ECTS cr (P1-P3)

580201A Biomedical Engineering Programming Study 5 ECTS cr

580202S Biomedical Engineering Project 5-10 ECTS cr

Tutkintorakenteet

Master's Degree programme in Biomedical Engineering, Master of Health Science (120 ect)

Tutkintorakenteen tila: published

Lukuvuosi: 2017-18

Lukuvuoden alkamispäivämäärä: 01.08.2017

Complementary Studies (enintään 60 op)

Compulsory studies for all (vähintään 50 op)

080925A: Anatomy and Physiology for Biomedical Engineering, 5 op
041201A: Basics in eHealth, 5 op
080928S: Biomedical Engineering Research Methods and Seminar, 5 op
521093S: Biomedical Instrumentation, 5 op
521273S: Biosignal Processing I, 5 op
080920S: Diagnostic Imaging, 5 op
521467A: Digital Image Processing, 5 op
521242A: Introduction to Biomedical Engineering, 5 op
580121A: Practical training, 1 - 5 op
521124S: Sensors and Measuring Techniques, 5 op

Advanced Studies (vähintään 30 op)

The student will choose one of the presented advanced modules and completes in it at least 30 ECTS cr including compulsory complementary project work 10 ECTS cr.

Biomedical Technology 20 ECTS cr + 10 ECTS cr

080924S: Biomaterials, 2 - 5 op
521240S: Biophotonics and Biomedical Optics, 5 op
080926A: Introduction to Biomedical Imaging Methods, 1 - 3 op
080922S: Microscopy and Spectroscopic Imaging, 5 op
080917S: Project in Biomedical Technology, 5 - 10 op
080915S: Tissue Biomechanics, 5 op
040911S: Using animals in research - carrying out procedures, 3 op

Medical Imaging 20op + 10op

080921S: Biomedical Ultrasound, 5 op
080926A: Introduction to Biomedical Imaging Methods, 1 - 3 op
521289S: Machine Learning, 5 op
521466S: Machine Vision, 5 op
080922S: Microscopy and Spectroscopic Imaging, 5 op
761652S: NMR Imaging, 10 op
080918S: Project in Medical Imaging, 5 - 10 op

Health technology 20 ECTS cr + 10 ECTS cr

521285S: Affective Computing, 5 op
080916S: Biomechanics of Human Movement, 5 op
521282S: Biosignal Processing II, 5 op
080927S: Connected Health and mHealth, 5 op
521430A: Electronic Measurement Techniques, 6 op
555333S: Production Management, 5 op
080919S: Project in Health Technology, 5 - 10 op
521097S: Wireless Measurements, 5 op

Master´s Thesis and Maturity Test (vähintään 30 op)

580213S: Master's Thesis in Biomedical Engineering, 30 op
580211S: Maturity Test, 0 op

Optional studies appr. 10 ECTS cr

With optional studies the student complements her/his studies up to the 120 ECTS cr required for the degree. Optional studies can include courses from other advanced modules or other intermediate or advanced courses provided by the university and related to the chosen field. When necessary, the student must agree on participation directly with the organizing unit. Recommended optional studies for Master degree:

080923S Physics in Radiation Therapy 5 ECTS cr (P4)

747604S Introduction to Biocomputing 3 ECTS cr (P2)

764322A Cell Membrane Biophysics 7 ECTS cr (P1-P2)

764629S Identification of Linear Systems 5 ECTS (P3)

031044A Mathematical Methods 3 ECTS cr (P1-P3)

464085A Patenting 5 ECTS cr (P3-P4)

812671S Usability Testing 5 ECTS cr (P3-P4)

521238S Optoelectronic Measurements 5 ECTS cr (P4)

521412A Digital Techniques I 5 ECTS cr (P1-P2)

521432A Electronics Design I 5 ECTS cr (P1-P2)

555242A Product Development 5 ECTS cr (P1-P3)

580201A Biomedical Engineering Programming Study 5 ECTS cr

580202S Biomedical Engineering Project 5-10 ECTS cr

Tutkintorakenteisiin kuulumattomat opintokokonaisuudet ja -jaksot

080923S: Physics in Radiation Therapy, 5 op

Opintojaksojen kuvaukset

Tutkintorakenteisiin kuuluvien opintokohteiden kuvaukset

080925A: Anatomy and Physiology for Biomedical Engineering, 5 op

Voimassaolo: 01.08.2017 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Health Sciences
Arvostelu: 1 - 5, pass, fail
Opettajat: Kyösti Heimonen, Miika Nieminen
Opintokohteen kielet: English

ECTS Credits:
5 ECTS credit points / 135 hours of work

Language of instruction:
English
Timing:
Master studies, Spring 2018, 4th period
Learning outcomes:
The student is able to define human anatomy and describe the physiological functions, and can explain how these can be investigated using different imaging methods and measurement systems
Contents:
The course acquaites the student to human physiology and anatomy. Areas covered include
Cells and tissues,
Skin, blood, blood circulation and the fluids of the body
Musculoskeletal organs
Defence reactions of the body
Respiration
Digestion,
Urine sectretion
Metabolic regulation, heat regulation
Reproduction
Sensory functions

Nervous system
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 28h, demonstrations 12h. Independent studying and preparing reports 95h. Final examination
Target group:
Biomedical engineering and physics students
Recommended optional programme components:
The coure is an independent entity and does not require additional studies carried out at the same time. Imaging methods are more closely studied in the course Diagnostic Imaging.
Recommended or required reading:
Supplementary reading will be given in the beginning of the course.
Assessment methods and criteria:
Taking part in the lectures and demonstrations. Written reports on demonstrations. Final exam.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Professor Miika Nieminen
Working life cooperation:
Course demonstrations will be held in hospital environment and are related to diagnostics.
Other information:
max. 40 students

041201A: Basics in eHealth, 5 op

Voimassaolo: 01.08.2011 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Medicine

Arvostelu: 1 - 5, pass, fail

Opettajat: Jarmo Reponen

Opintokohteen kielet: English

Leikkaavuudet:

ay041201A Basics in eHealth (OPEN UNI) 5.0 op

ECTS Credits:
5 ECTS credit points / 135 hours of work
Language of instruction:
English
Timing:
2nd period for exchange students, Faculty of Medicine
3rd period for degree students and other exchange students i.e. BME
Learning outcomes:
The student can define central information and communication technological terms and solutions in healthcare, and can list respective applications in healthcare services and training.
The student can evaluate the societal and economic significance of information and communication technology in healthcare
Contents:
- terms and concepts
- societal dimensions
- delivery of health services
- electronic patient records
- data transfer within the health care system
- data transfer between the health care professionals and the patients
- citizens providing their own health data, mHealth-solutions
- national healthcare information exchange in Finland- remote consultations, examples like teleradiology, telepsychiatry, telerehabilitation
- economical and functional assessment
- remote education

- future visions of health care information systems
- changing current topics in connected health like: AI, knowledge based medicine, cybersecurity, etc

Mode of delivery:
Web-based teaching
Learning activities and teaching methods:
Interactivity takes place in virtual learning environment Optima. The course consists of video-taped lectures, power point-presentations and links to other material available in the web. Performance of duties includes an essay, exam, participating in discussions on the grounds of the lectures.
Web lectures 15h / Web exam 40h / Written essay 40h* / Self-study and participation to web discussion 40h
(*Exchange student can relate their essay to the situation in their home countries)
Target group:
MSc and 3rd year BSc students of Biomedical Engineering and Medical Technology (medical technology, biomedical engineering, biophysics, physics, other degree programs), students of Health Sciences and information technology and everyone who is interested
Recommended or required reading:
All recommended or required reading are offered in Optima virtual learning environment
Assessment methods and criteria:
Web tasks, an essay and final exam
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course utilizes a numerical grading scale 1 – 5. In the numerical scale one stands for a fail.
Person responsible:
Professor Jarmo Reponen
Nina Keränen

080928S: Biomedical Engineering Research Methods and Seminar, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Health Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Jämsä, Timo Jaakko

Opintokohteen kielet: English

ECTS Credits:
5 ECTS credit points / 135 hours of work
Language of instruction:
English
Timing:
Master studies, Autumn, 1st period
Learning outcomes:
The student familiarizes with the principles of scientific work. The student can identify the essential features of scientific publications. The student can present the central content of a scientific article to others. The student can present critical questions related to a scientific presentation, and give and receive feedback on the presentations.
Contents:
Lectures, seminars and scientific literature. Publication forums in the field and characteristics of scientific articles.

Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Introduction lectures, presentations and discussion on the basis of the latest scientific publications. Each student will give two presentations and act as an opponent for two (peer-assessment).
Lectures 10h, seminars 20h, self-study 105h.
Target group:
Biomedical Engineering MSc students
Recommended optional programme components:
Prepares the student for thesis work.
Recommended or required reading:
Selected scientific articles and material indicated by lecturer
Assessment methods and criteria:

Attending seminars, making presentations and acting as an opponent. The assessment criteria are based on the learning outcomes of the course. The more detailed assessment criteria is found on Optima.
Read more about assessment criteria at the University of Oulu webpage.

Grading:
The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Professor Timo Jämsä
Working life cooperation:
The course prepares for working life.
Other information:
Also for doctoral studies

521093S: Biomedical Instrumentation, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Igor Meglinski

Opintokohteen kielet: Finnish

Leikkaavuudet:

521107S	Biomedical Instrumentation	6.0 op

ECTS Credits:
5
Language of instruction:
English.
Timing:
Period 3.
Learning outcomes:
After the course the student is capable to explain principles, applications and design of medical instruments most commonly used in hospitals. He/she can describe the electrical safety aspects of medical instruments and can present the physiological effects of electric current on humans. In addition the student is able to explain medical instrumentation development process and the factors affecting it. He/she also recognizes typical measurands and measuring spans and is able to plan and design a biosignal amplifier.

Contents:
Diagnostic instruments (common theories for medical devices, measurement quantities, sensors, amplifiers and registering instruments). Bioelectrical measurements (EKG, EEG, EMG, EOG, ERG), blood pressure and flow meters, respiration studies, measurements in a clinical laboratory, introduction to medical imaging methods and instruments, ear measurements, heart pacing and defibrillators, physical therapy devices, intensive care and operating room devices and electrical safety aspects.
Mode of delivery:
Face-to-face teaching.
Learning activities and teaching methods:
Lectures/exercises 42 h and self-study 100 h.
Target group:
Students interested in biomedical measurements.
Prerequisites and co-requisites:
None
Recommended optional programme components:
Course replaces earlier courses Biomedical measurements and Biomedical instrumentation.

Recommended or required reading:
R. S. Khandpur: Biomedical Instrumentation, Technology and Applications, McGraw-Hill, 2005 and J. G. Webster: Medical Instrumentation, Application and Design, 4th edition, John Wiley & Sons, 2010.
Assessment methods and criteria:
The course is passed by the final exam or optionally with the assignments/test agreed at the first lecture.

Read more about assessment criteria at the University of Oulu webpage.
Grading:
1 - 5.
Person responsible:
Igor Meglinski
Working life cooperation:
No.

521273S: Biosignal Processing I, 5 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Tapio Seppänen

Opintokohteen kielet: Finnish

ECTS Credits:
5 ECTS credits / 50 hours of work
Language of instruction:
English. Examination can be taken in English or Finnish.
Timing:
The course unit is held in the autumn semester, during period 2. It is recommended to complete the course at the end of studies.
Learning outcomes:
After completing the course, student
1. knows special characteristics of the biosignals and typical signal processing methods
2. can solve small-scale problems related to biosignal analysis
3. implement small-scale software for signal processing algorithms
Contents:
Biomedical signals. Digital filtering. Analysis in time-domain and frequency domain. Nonstationarity. Event detection. Signal characterization.
Mode of delivery:
Face-to-face teaching and guided laboratory work.
Learning activities and teaching methods:
Lectures 10h, Laboratory work 20h, Self-study 20h, written examination.
Target group:
Students interested in biomedical engineering, at their master's level studies.
Students of the University of Oulu.

Prerequisites and co-requisites:
The mathematic studies of the candidate degree program of computer science and engineering, or equivalent. Programming skills, especially basics of the Matlab. Basic knowledge of digital signal processing.
Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time.
Recommended or required reading:
The course is based on selected chapters of the book "Biomedical Signal Analysis", R.M Rangayyan, 2nd edition (2015). + Lecture slides + Task assignment specific material.
Assessment methods and criteria:
Laboratory work is supervised by assistants who also check that the task assignments are completed properly. All task assignments are compulsory. The course ends with a written exam.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Tapio Seppänen
Working life cooperation:
No.
Other information:
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080920S: Diagnostic Imaging, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Health Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Miika Nieminen

Opintokohteen kielet: English

ECTS Credits:
5 ECTS credit points / 135 hours of work

Language of instruction:
English
Timing:
Master studies, Autumn 2017, 1st and 2nd periods
Learning outcomes:
The student is able to define the physical principles on which various medical imaging devices are based upon.
Contents:
The course acquaints the students to the basic physics related to imaging modalities and therapeutic systems used in hospitals. Covered topics include e.g. x-ray imaging, computed tomography, magnetic resonance imaging, nuclear medicine and methods of clinical neurophysiology.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 26h, demonstrations 8h, excercises 4h, independent studying and preparing reports 97h. Final exam.
Target group:
Biomedical Engineering MSc students (medical technology, information technology, and other related degree programs), Physics MSc students (biophysics/medical physics) and other minor subject students. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
Recommended: physics basic courses and Radiation physics, biology and safety (766116P, 761116P, 764117P or 764317A).
Recommended optional programme components:
BME-courses
Recommended or required reading:
Dowsett, Kenny, Johnston: The Physics of Diagnostic Imaging, 2nd ed., Hodder Arnold, 2006.

Assessment methods and criteria:
Taking part in the lectures and demos. Written report on demonstrations. Final exam.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Professor Miika Nieminen
Working life cooperation:
Demonstrations are held in hospital environment and are related to diagnostics.

521467A: Digital Image Processing, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Heikkilä, Janne Tapani

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay521467A Digital Image Processing (OPEN UNI) 5.0 op

ECTS Credits:
5 ECTS credits / 133 hours of work
Language of instruction:
Lectures in Finnish and exercises in English. Course can be passed in Finnish and English.
Timing:
Autumn, period 1.
Learning outcomes:
Upon completion of the course the student:
- understands the basic theory of digital image processing and knows its main applications,
- is able to apply spatial and frequency domain and wavelet based methods in image enhancement, restoration, compression and segmentation.

Contents:
1. Fundamentals of digital images, 2. Image enhancement in spatial and frequency domains, 3.Image restoration, 4. Color image processing, 5. Wavelets, 6. Image compression, 7. Morphological image processing and 8. Image segmentation.
Mode of delivery:
Face-to-face teaching.
Learning activities and teaching methods:
Lectures 24 h, exercises 14 h and homework assignments 30 h. The rest is independent work.
Target group:
Computer Science and Engineering students and other Students of the University of Oulu.
Prerequisites and co-requisites:
None.
Recommended optional programme components:
In order to obtain deep understanding of the content, it is a benefit if the student has completed the mathematics courses in the computer science and engineering BSc program or otherwise has equivalent knowledge.
Recommended or required reading:
Gonzalez, R.C., Woods, R.E.: Digital Image Processing, Third Edition, Prentice-Hall, 2008, Chapters 1-10. Lecture notes and exercise
Assessment methods and criteria:
The course is completed by passing the exam and homework assignments.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Janne Heikkilä
Working life cooperation:
None.
Other information:
-

521242A: Introduction to Biomedical Engineering, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Teemu Myllylä

Opintokohteen kielet: English

ECTS Credits:
5 ECTS cr
Language of instruction:
English
Timing:
Period 1
Learning outcomes:
After completing the course, the student has a basic knowledge of the biomedical engineering discipline and the applications of engineering science to biomedical problems.
Contents:
Biomedical engineering is a highly multidisciplinary field of study that ranges from theory to applications at the interface between such as engineering, biophotonics, medicine and biology. This course will introduce the subdisciplines within biomedical engineering, including systems physiology, bioinstrumentation, bioimaging and biomedical signal analysis. General issues of each of the subdisciplines will be illustrated together with selected examples and clinical applications. A number of lectures will be given by different lecturers working in health tech companies, University of Oulu and Oulu University Hospital, presenting the fields of the biomedical engineering. In addition, course offerings of biomedical engineering at the University of Oulu are introduced.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
The course includes lectures, demonstrations and a group project.
Target group:
-
Prerequisites and co-requisites:
-
Recommended optional programme components:
-
Recommended or required reading:
-
Assessment methods and criteria:
University exam
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course utilizes a numerical grading scale 1-5. In the numerical
scale zero stands for a fail.
Person responsible:
Teemu Myllylä
Working life cooperation:
Guest lecturers
Other information:
-

580121A: Practical training, 1 - 5 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Intermediate Studies

Laji: Practical training

Vastuuyksikkö: Health Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Jämsä, Timo Jaakko

Opintokohteen kielet: Finnish

ECTS Credits:
1-5 ECTS credits/ 27-135 hours of work
Language of instruction:
Finnish / English
Timing:
The course can be taken during Master studies in autumn or spring semester, or during the summer period.
Learning outcomes:
Upon completion of the course, the student will be able to
- know basic skills in working life,

- recognize his/hers own skills,
- is able to present those in the CV.

Contents:
Practical training in the field.
Mode of delivery:
Practical training in the field.
Learning activities and teaching methods:
The student finds the place for practical training by him/herself and agrees on the training together with the person in charge. 1 ECTS credit equals two weeks of training. Practical training includes writing a plan before the training and afterwards updating the CV and evaluation of the learned skills. Documents are accepted by person responsible. The course can be compensated based on earlier working experince using RPL-protocol (recognition of prior learning).

Target group:
Master degree students of Biomedical Engineering or Medical Technology
Prerequisites and co-requisites:
Student needs to have adequate basic skills for the training tasks.
Recommended optional programme components:
The course is an indpendent entity but the student is expected to have adequate skills for the training.
Assessment methods and criteria:
Before the training period the eligibility of the position is evaluated by the person responsible. Before the training students makes a plan for the trainig and the objectives. After the training period student evaluates skills learned regarding working skills and studies. Student provides letter of reference and other documentations (CV and application form) for the person reponsible. If course is compensated based on earlier working experince student fills RPL-form, updates CV and delivers them for person responsible for evaluation.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course utilizes grading pass / fail.
Person responsible:
Dr Maarit Kangas
Working life cooperation:
Practical training can take place in companies, universities or other reseach organisations.

521124S: Sensors and Measuring Techniques, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Igor Meglinski, Teemu Myllylä

Opintokohteen kielet: Finnish

ECTS Credits:
5
Language of instruction:
English.

Timing:
Period 1.
Learning outcomes:
After the course the student is capable to explain the operating principles of different sensors and can select a right sensor for each measuring target. He/she is able to quantify the requirements that affect sensor selection as well as recognize and evaluate the uncertainty of a measurement. In addition the student is able to plan and design sensor signal conditioning circuits.
Contents:
Methods for measuring displacement, velocity, acceleration, torque, liquid level, pressure, flow, humidity, sound and temperature. Ultrasound, optical and nuclear measurement techniques and applications, material analyses such as pH measurement and gas concentration, pulp and paper measurements and smart sensors.
Mode of delivery:
Pure face-to-face teaching.
Learning activities and teaching methods:

Lectures 26h, exercises 12h and self-study 100h.
Target group:
4 year students.
Prerequisites and co-requisites:
No.
Recommended optional programme components:
No.
Recommended or required reading:
H. N. Norton: Handbook of Transducers, Prentice Hall P T R, 1989 or 2002; lecture and exercise notes.
Assessment methods and criteria:
The course is passed by a final exam and passed exercises.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
1-5
Person responsible:
Igor Meglinski, Teemu Myllylä
Working life cooperation:
No.

080924S: Biomaterials, 2 - 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Health Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

ECTS Credits:
2-5 ECTS credit points / 54-135 hours of work.
Language of instruction:
English
Timing:
Master studies, autumn, 2nd period. The course is not organized in 2017.
Learning outcomes:
The student can list essential biological and tissue-replacing materials and can describe their properties. The student identifies and can explain the basics of interactions between biomaterials and tissues.
Contents:
Biocompatibility, metallic and ceramic implantation materials, polymers, biodegradable materials, bioglass, multifunctional biomaterials, tissue engineering, examples of applications.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Scope and credits of the course and the methods of implementation vary.
Lectures 18 h. Self-study 36-117 h. Written report.
Target group:
Master Students of Biomedical Engineering and Medical Technology. Other students who are interested in biomaterials
Recommended or required reading:
Lecture material. Literature: Introduction to biomaterials: Basic Theory with Engineering Application. C. Mauli Agrawal. Joo L. Ong, Mark R. Appleford, and Gopinath Mani. Cambridge texts in Biomedical Engineering
Assessment methods and criteria:
Participating to class, given exercises, written report.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course utilizes a numerical grading scale 1-5 based on the written report. In the numerical scale zero stands for a fail.
Person responsible:
Professor Timo Jämsä

521240S: Biophotonics and Biomedical Optics, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Igor Meglinski

Opintokohteen kielet: Finnish

ECTS Credits:
5
Language of instruction:
English
Timing:
Period 2
Learning outcomes:
On successful completion of the course, students will be able to categorize the basic principles of modern optical and laser-based diagnostic modalities and instruments used in advanced biomedical research and clinical medicine. They will be able to demonstrate detailed understanding and evaluate the key biophotonics techniques underlying day-to-day clinical diagnostic and therapies and industrial applications in pharmacy, health care and cosmetic products. They can operate with the selected techniques of their choice.
Contents:
The course includes in-depth coverage of state-of-the-art optical imaging and spectroscopy systems for advanced biomedical research and clinical diagnosis, fundamental properties of light such as coherence, polarization, angular momentum, details of light interaction with tissue, and modern imaging system. Coherent Optical Tomography (OCT), Laser Doppler Flowmetry, Laser Speckle Imaging (LSI), Photo-Acoustic Tomography (PAT), Tissue polarimetry; Optical and Near-Infra-Red Spectroscopy (NIRS), Confocal and Fluorescence Microscopies; Tissue Optics: Light /matter interactions, index of refraction, reflection, optical clearing, absorption, Mie scattering, Rayleigh scattering, Monte Carlo modelling.
Mode of delivery:
Face-to-face teaching.
Learning activities and teaching methods:
Lectures/exercises 42 h and self-study 100 h.
Target group:
Students interested in biomedical measurements.
Prerequisites and co-requisites:
None.
Recommended optional programme components:
A new course
Recommended or required reading:
V.V Tuchin: Handbook of Optical Biomedical Diagnostics, SPIE Press, 2002; V.V Tuchin: Handbook of Coherent Domain Optical Methods, Springer, 2nd edition, 2013. D.A Boas, C. Pitris, N. Ramanujam, Handbook of Biomedical Optics, CRC Press, 2011.
Assessment methods and criteria:
The course is passed by the final exam and with the assignments.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
1 - 5
Person responsible:
Igor Meglinski
Working life cooperation:
No.

080926A: Introduction to Biomedical Imaging Methods, 1 - 3 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Health Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

ECTS Credits:
1-3 ECTS credit points / 27-81 hours of work.
Language of instruction:
English
Timing:
Master studies, 3rd or 4th period.
Learning outcomes:
The student understands and can describe the basic principles and main applications of imaging methods used in biomedical research.
Contents:
Differences between in vivo, ex vivo and in vitro imaging. Light and electron microscopy. Optical projection and coherence tomography. Optical in vivo imaging. Magnetic resonance imaging. Fourier transform infrared imaging spectroscopy. Raman imaging spectroscopy. Micro-computed tomography. Ultrasound imaging. Basics of image analysis and interpretation
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Scope of the course and the methods of implementation vary. The course includes lectures 16h and demonstrations 8h. Independent study is determined by the extent of the course to 3-57 hours. The course includes a final exam.

Target group:
All students who are interested in methods of biomedical imaging. The course is suitable for both Master and Doctoral students.
Recommended or required reading:
Required literature is given in the lectures.
Assessment methods and criteria:
Participation in the lectures and demonstrations (compulsory). Written exam (3 ECTS). The course can be taken as 1, 2 or 3 ECTS.
1 ECTS # participation in all the lectures
2 ECTS # participation in all the lectures and demonstrations
3 ECTS # participation in the lectures and demonstrations + final exam
Read more about assessment criteria at the University of Oulu webpage.

Grading:
The 1 and 2 ECTS courses utilize verbal grading: pass or fail. The 3 ECTS course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Postdoctoral researcher Lassi Rieppo

080922S: Microscopy and Spectroscopic Imaging, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Health Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Simo Saarakkala

Opintokohteen kielet: English

ECTS Credits:
5 ECTS credit points /135 hours of work.
Language of instruction:
English
Timing:
The course is held in the spring semester during period 4. It is recommended to complete the course during Master studies. The course is not organized every year.
Learning outcomes:
Upon completion of the course, the student can:

- Explain the physical and technical background of conventional optical microscopy, micro-computed tomography, atomic force microscopy, visible light imaging spectroscopy, fourier-transform infrared imaging spectroscopy and Raman imaging spectroscopy
- Understand and describe the concept and differences between grayscale image, RGB image and spectral image
- Perform microscopic and spectroscopic imaging in practice
- Perform basic quantitative analysis for microscopic images
- Perform univariate and multivariate analysis for spectral image data

Contents:

- Introduction to microscopy and spectroscopic imaging
- Quantitative imaging and basic image analysis methods
- Bright field microscopy and digital densitometry
- Polarized light microscopy
- Phase-contrast microscopy, differential interference contrast microscopy, and confocal microscopy
- Micro-computed tomography
- Atomic force microscopy
- Optical imaging spectroscopy, Fourier-transform infrared imaging spectroscopy and Raman imaging spectroscopy
- Univariate and multivariate spectral analysis methods

Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 20 h / Exercises 8 h / Demonstrations 6 h, Practical microscopy assignment 15 h / Self-study 86 h. Final exam.
Target group:
Master students of Biomedical Engineering (all degree programs) and Physics (biomedical physics major and other minor subject students). The course is also suitable for other interested students with adequate prerequisites.
Prerequisites and co-requisites:
Basic knowledge on physics, calculus, differential equations and matrix algebra is required. The ability to use Matlab software is recommended as it will be used in the exercises.
Recommended or required reading:
Material given during lectures.
Assessment methods and criteria:
Accepted exercises, assignment and written final exam. The final exam is based on lectures and other given materials, and it includes definition and explanation assignments and problems (including mathematical calculations). Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:
Associate Professor Simo Saarakkala

080917S: Project in Biomedical Technology, 5 - 10 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Health Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Jämsä, Timo Jaakko

Opintokohteen kielet: Finnish

ECTS Credits:
10 ECTS credit points / 270 hours of work.
Language of instruction:
Finnish / English
Timing:
The course can be taken during Master studies in autumn or spring semester, or during the summer period.
Learning outcomes:

Upon completion of the course, the student will be able to solve a research or development problem and report it in writing and by oral presentation.
Contents:
Performing a small project example on reseach topic or development.
Mode of delivery:
Independent work.
Learning activities and teaching methods:
The student participates in project within or outside the university. Project topics are offered in Optima. The student prepares a personal project plan according to separate specifications, participates in seminars, prepares a written research report and presents it in a seminar.
Target group:
Master degree students of the Biomedical Engineering or Medical Technology (primarily for students from Medical Faculty).
Recommended optional programme components:
The course is an indpendent entity.
Assessment methods and criteria:
Students prepares a project plan, participates in seminars, and reports project results in written report and by oral presentation.
Read more about assessment criteria at the University of Oulu webpage.

Grading:
The course utilizes grading scale pass/fail.
Person responsible:
Dr Lassi Rieppo
Working life cooperation:
Project can be commissioned by a company or other organisation. Topic and supervision is agreed together with the organisation.

080915S: Tissue Biomechanics, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Health Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

ECTS Credits:
5 ECTS credit points /135 hours of work.
Language of instruction:
English
Timing:
The course is held in the autumn semester, during period 1. It is recommended to complete the course during Master studies.
Learning outcomes:
The student can describe the main biomechanical characteristics of different tissues as well as their failure mechanisms. The student can perform practical biomechanical experiments, analyze measurement data, interpret results, and report them using good scientific reporting practice. The student understand how numerical modeling can be used to solve problems in tissue biomechanics.

Contents:
Introduction to tissue biomechanics. Most important biomechanical parameters and material models. Experimental measurements of biomechanical properties of tissues. Structure, composition and mechanical properties of different tissues. Biomechanical modeling of tissues.

Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 15h / Exercises 8h / Assignment 8h / Self-study 104h. Final exam.

Target group:

Master students of Biomedical Engineering (all degree programs) and Physics (biomedical physics major and other minor subject students). The course is also suitable for other interested students with adequate prerequisites.

Prerequisites and co-requisites:
It is recommended that the student has basic knowledge on cell biology, anatomy and physiology, mechanics, differential equations, and matrix algebra.

Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time. Motion biomechanics will be studied on the course 080916S Biomechanics of Human Movement.
Recommended or required reading:
Material given during the course.

Assessment methods and criteria:
Accepted exercises, assignment and written final exam. The final exam is based on lectures and other given materials, and it includes definition and explanation assignments and problems (including mathematical calculations). Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Associate Professor Simo Saarakkala
Other information:

040911S: Using animals in research - carrying out procedures, 3 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Laboratory Animal Centre

Arvostelu: 1 - 5, pass, fail

Opettajat: Voipio Hanna-marja

Opintokohteen kielet: Finnish

Leikkaavuudet:

040900S	Using animals in research - carrying out procedures	2.5 op

Ei opintojaksokuvauksia.

080921S: Biomedical Ultrasound, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Health Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Heikki Nieminen

Opintokohteen kielet: English

ECTS Credits:
5 ECTS credit points / 135 hours of work.
Language of instruction:
English
Timing:
The course is held in the spring semester, during period III in even years. It is recommended to complete the course during master studies.

Learning outcomes:
Upon completion of the course, the student will be able to:
- Masters the basics of ultrasound physics
- Understands the working principles of methods used in research and clinic

Contents:
Ultrasound has enabled establishment of emerging technologies for biomedicine in characterization and therapy. This course focuses ultrasound physics behind these technologies. Research and clinical applications exploiting this physics, such as elastography, quantitative tissue characterization, drug delivery, ultrasound surgery (HIFU), acoustic levitation, tissue actuation and tissue stimulation by ultrasound, will be elaborated.

Mode of delivery:
The course is delivered as face-to-face teaching and partially as distance teaching. The course includes independent work.
Learning activities and teaching methods:
Lectures 24 h. Excercises 8 h. Independent work 40 h. Project study 30 h with a report and oral presentation 33 h.
Target group:
Master students in Biomedical Engineering and Physics, and other interested Master level students.

Prerequisites and co-requisites:
The required prerequisite is the completion of the following course or corresponding information to enrolling for the course: 080920S Diagnostic Imaging 5 credits.
Recommended optional programme components:
The course and the following courses support each other: 080926A Introduction to Biomedical Imaging Methods 1-3 credits, and 080922S Microscopy and Spectroscopic Imaging 5 credits.

Recommended or required reading:
Lecture slides and presented literature.
Assessment methods and criteria:
Taking part in lectures, conducting excercises, preparation of the course work (report + oral presentation).
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course utilizes numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Docent Heikki Nieminen

080926A: Introduction to Biomedical Imaging Methods, 1 - 3 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Health Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

ECTS Credits:
1-3 ECTS credit points / 27-81 hours of work.
Language of instruction:
English
Timing:
Master studies, 3rd or 4th period.
Learning outcomes:
The student understands and can describe the basic principles and main applications of imaging methods used in biomedical research.
Contents:
Differences between in vivo, ex vivo and in vitro imaging. Light and electron microscopy. Optical projection and coherence tomography. Optical in vivo imaging. Magnetic resonance imaging. Fourier transform infrared imaging spectroscopy. Raman imaging spectroscopy. Micro-computed tomography. Ultrasound imaging. Basics of image analysis and interpretation
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:

Scope of the course and the methods of implementation vary. The course includes lectures 16h and demonstrations 8h. Independent study is determined by the extent of the course to 3-57 hours. The course includes a final exam.

Target group:
All students who are interested in methods of biomedical imaging. The course is suitable for both Master and Doctoral students.
Recommended or required reading:
Required literature is given in the lectures.
Assessment methods and criteria:
Participation in the lectures and demonstrations (compulsory). Written exam (3 ECTS). The course can be taken as 1, 2 or 3 ECTS.
1 ECTS # participation in all the lectures
2 ECTS # participation in all the lectures and demonstrations
3 ECTS # participation in the lectures and demonstrations + final exam
Read more about assessment criteria at the University of Oulu webpage.

Grading:
The 1 and 2 ECTS courses utilize verbal grading: pass or fail. The 3 ECTS course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Postdoctoral researcher Lassi Rieppo

521289S: Machine Learning, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Tapio Seppänen

Opintokohteen kielet: Finnish

Leikkaavuudet:

521497S-01	Pattern Recognition and Neural Networks, Exam	0.0 op
521497S-02	Pattern Recognition and Neural Networks; Exercise Work	0.0 op
521497S	Pattern Recognition and Neural Networks	5.0 op

ECTS Credits:
5 ECTS cr
Language of instruction:
English. Examination can be taken in English or Finnish.
Timing:
The course unit is held in the spring semester, during period III. It is recommended to complete the course at the end of studies.
Learning outcomes:
After completing the course, student
1. can design simple optimal classifiers from the basic theory and assess their performance.

2. can explain the Bayesian decision theory and apply it to derive minimum error classifiers and minimum cost classifiers.

3. can apply the basics of gradient search method to design a linear discriminant function.

4. can apply regression techniques to practical machine learning problems.
Contents:
Introduction. Bayesian decision theory. Discriminant functions. Parametric and non-parametric classification. Feature extraction. Classifier design. Example classifiers. Statistical regression methods.
Mode of delivery:
Face-to-face teaching, guided laboratory work and independent assignment.
Learning activities and teaching methods:
Lectures 10h, Laboratory work 20h, Self-study 20h, Independent task assignment, written examination.

Target group:
Students who are interested in data analysis technology. Students of the University of Oulu.
Prerequisites and co-requisites:
The mathematic studies of the candidate degree program of computer science and engineering, or equivalent. Programming skills, especially basics of the Matlab.
Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time.
Recommended or required reading:
Duda RO, Hart PE, Stork DG, Pattern classification, John Wiley & Sons Inc., 2nd edition, 2001. Handouts.
Assessment methods and criteria:
Laboratory work is supervised by assistants who also check that the task assignments are completed properly. The independent task assignment is graded. The course ends with a written exam.
Read more about assessment criteria at the University of Oulu webpage.

Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail. The final grade is established by weighing the written exam by 2/3 and the task assignment by 1/3.
Person responsible:
Tapio Seppänen
Working life cooperation:
No
Other information:
-

521466S: Machine Vision, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Heikkilä, Janne Tapani

Opintokohteen kielet: Finnish

ECTS Credits:
5 ECTS cr
Language of instruction:
English
Timing:
Spring, period 3.
Learning outcomes:
After completing the course, student
1. can utilize common machine vision methods for various image analysis problems

2. can detect and recognize objects using features computed from images

3. can use motion information in image analysis

4. can use model matching in image registration and object recognition

5. can explain the basics of geometric computer vision

6. can calibrate cameras

7. can use stereo imaging for 3D reconstruction

8. can use Matlab for implementing basic machine vision algorithms
Contents:
Course provides an introduction to machine vision, and its applications to practical image analysis problems. Common computer vision methods and algorithms as well as principles of image formation are studied. Topics: 1.

Introduction, 2. Imaging and image representation, 3. Color and shading, 4. Image features, 5. Recognition, 6. Texture, 7. Motion from 2D image sequences, 8. Matching in 2D, 9. Perceiving 3D from 2D images, 10. 3D reconstruction.

Mode of delivery:
Face-to-face teaching, homework assignments.

Learning activities and teaching methods:
Lectures (20 h), exercises (16 h) and Matlab homework assignments (16 h).

Target group:
Computer Science and Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:
521467A Digital Image Processing

Recommended optional programme components:
521289S Machine Learning. This courses provide complementary information on machine learning methods applied in machine vision. It is recommended to be studied simultaneously.

Recommended or required reading:
Lecture notes and exercise material. The following books are recommended for further information: 1) Shapiro, L.G., Stockman,G.C.: Computer Vision, Prentice Hall, 2001. 2) R. Szeliski: Computer Vision: Algorithms and Applications, Springer, 2011. 3) D.A. Forsyth & J. Ponce: Computer Vision: A Modern Approach, Prentice Hall, 2002.

Assessment methods and criteria:
The course is passed with final exam and accepted homework assignments.
Read more about assessment criteria at the University of Oulu webpage.

Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:
Janne Heikkilä

Working life cooperation:
No.

Other information:
-

080922S: Microscopy and Spectroscopic Imaging, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Health Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Simo Saarakkala

Opintokohteen kielet: English

ECTS Credits:
5 ECTS credit points /135 hours of work.

Language of instruction:
English

Timing:
The course is held in the spring semester during period 4. It is recommended to complete the course during Master studies. The course is not organized every year.

Learning outcomes:
Upon completion of the course, the student can:

- Explain the physical and technical background of conventional optical microscopy, micro-computed tomography, atomic force microscopy, visible light imaging spectroscopy, fourier-transform infrared imaging spectroscopy and Raman imaging spectroscopy
- Understand and describe the concept and differences between grayscale image, RGB image and spectral image
- Perform microscopic and spectroscopic imaging in practice
- Perform basic quantitative analysis for microscopic images
- Perform univariate and multivariate analysis for spectral image data

Contents:

- Introduction to microscopy and spectroscopic imaging
- Quantitative imaging and basic image analysis methods
- Bright field microscopy and digital densitometry

- Polarized light microscopy
- Phase-contrast microscopy, differential interference contrast microscopy, and confocal microscopy
- Micro-computed tomography
- Atomic force microscopy
- Optical imaging spectroscopy, Fourier-transform infrared imaging spectroscopy and Raman imaging spectroscopy
- Univariate and multivariate spectral analysis methods

Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 20 h / Exercises 8 h / Demonstrations 6 h, Practical microscopy assignment 15 h / Self-study 86 h. Final exam.
Target group:
Master students of Biomedical Engineering (all degree programs) and Physics (biomedical physics major and other minor subject students). The course is also suitable for other interested students with adequate prerequisites.
Prerequisites and co-requisites:
Basic knowledge on physics, calculus, differential equations and matrix algebra is required. The ability to use Matlab software is recommended as it will be used in the exercises.
Recommended or required reading:
Material given during lectures.
Assessment methods and criteria:
Accepted exercises, assignment and written final exam. The final exam is based on lectures and other given materials, and it includes definition and explanation assignments and problems (including mathematical calculations). Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:
Associate Professor Simo Saarakkala

761652S: NMR Imaging, 10 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Ville-Veikko Telkki

Opintokohteen kielet: Finnish, English

ECTS Credits:
10 ECTS credits / 266 hours of work
Language of instruction:
English
Timing:
Every second year (odd year), autumn
Learning outcomes:
After completion, student understands the principles of the imaging methods based on nuclear magnetic resonance (NMR) and how NMR imaging can be used to characterize physical properties of various materials.
Contents:
Topics include one-dimensional Fourier imaging, k space, gradient echoes, multidimensional Fourier imaging, continuous and discrete Fourier transform, sampling, folding, filtering, resolution, and contrast.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 44 h, exercises 20 h, self-study 149 h
Target group:
Primarily for the students of the degree programmes in physics and chemistry. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:

761663S NMR spectroscopy is helpful, but not necessary.
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Textbooks: E. M. Haake, R. W. Brown, M. R. Thompson and R. Venkatesan, Magnetic Resonance Imaging. Physical Principles and Sequence Design., John Wiley & Sons, Inc., 1999 (in part), B. Blümich, NMR Imaging of Materials, Clarendon Press, 2000 (in part).
Assessment methods and criteria:
One written examination.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Ville-Veikko Telkki
Working life cooperation:
No work placement period
Other information:
Course website

080918S: Project in Medical Imaging, 5 - 10 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Health Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Jämsä, Timo Jaakko

Opintokohteen kielet: Finnish

ECTS Credits:
10 ECTS credit points / 270 hours of work.
Language of instruction:
Finnish / English
Timing:
The course can be taken during Master studies in autumn or spring semester, or during the summer period.
Learning outcomes:
Upon completion of the course, the student will be able to solve a research or development problem and report it in writing and by oral presentation.
Contents:
Performing a small project example on reseach topic or development.
Mode of delivery:
Independent work.
Learning activities and teaching methods:
The student participates in project within or outside the university. Project topics are offered in Optima. The student prepares a personal project plan according to separate specifications, participates seminars, prepares a written research report and presents it in a seminar.
Target group:
Master degree students of the Biomedical Engineering or Medical Technology (primarily for students from Medical Faculty).
Recommended optional programme components:
The course is an indpendent entity.
Assessment methods and criteria:
Students prepares a project plan, participates in seminars, and reports project results in written report and by oral presentation.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course utilizes grading scale pass/fail.
Person responsible:
Professor Timo Jämsä
Working life cooperation:
Project can be commissioned by a company or other organisation. Topic and supervision is agreed together with the organisation.

521285S: Affective Computing, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Guoying Zhao

Opintokohteen kielet: English

ECTS Credits:
5 ECTS cr
Language of instruction:
English
Timing:
The course is held in the autumn semester, during periods I and II. It is recommended to complete the course at the 1st autumn semester.
Learning outcomes:
After completing the course, student
1. is able to explain the emotion theory and modeling

2. is able to implement algorithms for emotion recognition from visual and audio signals or the fusion of multi-modalities

3. has the ideas of wide applications of affective computing
Contents:
The history and evolution of affective computing; psychological study about emotion theory and modeling; emotion recognition from different modalities: facial expression, speech, EEG; crowdsourcing study; synthesis of emotional behaviors; emotion applications.
Mode of delivery:
Face to face teaching
Learning activities and teaching methods:
The course consists of lectures and exercises. The final grade is based on the points from exam while there are several mandatory exercises.
Target group:
Computer Science and Engineering students and other Students of the University of Oulu.
Prerequisites and co-requisites:
A prior programming knowledge, possibly the bachelor level mathematical studies and/or some lower level intermediate studies (e.g. computer engineering or artificial intelligence courses). The recommended optional studies include the advanced level studies e.g. the pattern recognition and neural networks and/or computer vision courses.
Recommended optional programme components:
-
Recommended or required reading:
All necessary material will be provided by the instructor.
Assessment methods and criteria:
The assessment of the course is based on the exam (100%) with mandatory exercises.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 1-5; zero stands for a fail.
Person responsible:
Guoying Zhao, Eero Väyrynen, Xiaohua Huang
Working life cooperation:
-
Other information:
-

080916S: Biomechanics of Human Movement, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Health Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Jämsä, Timo Jaakko

Opintokohteen kielet: English

ECTS Credits:
5 ECTS credit points / 135 hours of work.
Language of instruction:
English
Timing:
Master studies, 3rd period
Learning outcomes:
The student can describe the main challenges of movement biomechanics and principles for motion analysis. The student knows basics of biomechanical measurement and modeling of movement. The student can perform practical biomechanical experiments, analyze measurement data, interpret results, and report them using good scientific reporting practice.

Contents:
Musculoskeletal biomechanics. Motion sensors and motion analysis. Biomechanical modeling ofmovement. Balance measurement. Fall biomechanics. Measurement of physical activity.

Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 14h / Assignment 54h / Self-study 67h. Final exam.
Target group:
Biomedical Engineering MSc students (medical technology, information technology, other related degree programs). Physics MSc students (biophysics, medical physics). Other interested MSc students.
Prerequisites and co-requisites:
It is recommended to have basic knowledge on anatomy and physiology, statistical analysis, sensors and measurement techniques and signal processing.

Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time. Tissue biomechanics will be studied on the course 080915S.
Recommended or required reading:
Material given during lectures.
Assessment methods and criteria:
Accepted home exercises and assignments, written exam. The exam includes definition and explanation assignments and problems.
Read more about assessment criteria at the University of Oulu webpage.

Grading:
The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Professor Timo Jämsä
Working life cooperation:
None

521282S: Biosignal Processing II, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Jukka Kortelainen

Opintokohteen kielet: Finnish

Voidaan suorittaa useasti: Kyllä

ECTS Credits:
5 ECTS cr
Language of instruction:
Lectures and laboratory works are given in English. The examination can be taken in Finnish or English.
Timing:
Period 4
Learning outcomes:
After completing the course, student
1. knows the special characteristics of neural signals and the typical signal processing methods related to them

2. can solve advanced problems related to the neural signal analysis
Contents:
Introduction to neural signals, artifact removal, anesthesia and natural sleep, topographic analysis and source localization, epilepsy, evoked potentials.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures (8 h) and laboratory work (20 h), written exam.
Target group:
Engineering students, medical and wellness technology students, and other students interested in biomedical engineering. Students of the University of Oulu.
Prerequisites and co-requisites:
The basic engineering math courses, digital filtering, programming skills, Biosignal Processing I.
Recommended optional programme components:
-
Recommended or required reading:
The course is based on selected parts from books "EEG Signal Processing", S. Sanei and J. A. Chambers, "Bioelectrical Signal Processing in Cardiac and Neurological Applications", L. Sörnmo and P. Laguna, and "Neural Engineering", B. He (ed.) as well as lecture slides and task assignment specific material.
Assessment methods and criteria:
Laboratory work is supervised by the assistants who will also check that the task assignments are completed properly. The course ends with a written exam.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading of the accepted exam is in the range 1-5.
Person responsible:
Jukka Kortelainen
Working life cooperation:
-
Other information:
-

080927S: Connected Health and mHealth, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Health Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Jarmo Reponen

Opintokohteen kielet: English

ECTS Credits:
5 ECTS credit points / 135 hours of work
Language of instruction:
English
Timing:
1st period in even years

Learning outcomes:
The student can define central information and communication technological terms and solutions in healthcare related to connected health and mHealth.
Contents:
Will be specified in 2018
Mode of delivery:
Will be specified in 2018
Learning activities and teaching methods:
Will be specified in 2018
Target group:
MSc and 3rd year BSc students of Biomedical Engineering and Medical Technology (medical technology, biomedical engineering, biophysics, physics, other degree programs), students of Health Sciences and information technology and everyone who is interested
Assessment methods and criteria:
Will be specified in 2018
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course utilizes a numerical grading scale 1 – 5. In the numerical scale one stands for a fail.
Person responsible:
Professor Jarmo Reponen

521430A: Electronic Measurement Techniques, 6 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Saarela

Opintokohteen kielet: Finnish

Leikkaavuudet:

521092A	Electronic Measurement Techniques	5.0 op
521171A	Electronic Measurement Techniques	6.5 op
521171A-01	Electronic measurement techniques, exam	0.0 op
521171A-02	Electronic measurement techniques, exercise work	0.0 op

Ei opintojaksokuvauksia.

555333S: Production Management, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Industrial Engineering and Management

Arvostelu: 1 - 5, pass, fail

Opettajat: Kess, Pekka Antero

Opintokohteen kielet: English

Leikkaavuudet:

555322S	Production Management	3.0 op

ECTS Credits:
5 ECTS credits.
Language of instruction:
English
Timing:
Period 2.
Learning outcomes:

Upon completion of the course, the student will be able to:

- understand the key concepts of operations and production management
- know the essential production strategies
- understand the principles of the supply chain management, and should be able to apply JIT, Lean and TOC methods in analysing and constructing development plans for production organisations
- apply the management methods also in service systems
- understand the principles of the sustainable development in production

Contents:
Production strategies, sustainable development, Supply Chain Management, Just-In-Time (JIT), Theory of Constraints (TOC), Lean, Toyota Production System (TPS), management of the production of services.
Mode of delivery:
The tuition will be implemented as blended teaching (face-to-face teaching and a supervised group work).
Learning activities and teaching methods:
Lectures 20 h, assignment guidance 20 h, group work 94 h.
Target group:
Industrial Engineering and Management and Master's Programme in Product Management students.
Prerequisites and co-requisites:
B.Sc. in Industrial Engineering and Management or equivalent.
Recommended optional programme components:
-
Recommended or required reading:
Liker J (2004) The Toyota Way: 14 Management Principles from the World's Greatest Manufacturer. Goldratt, E. M. (2012) The Goal: A Process of Ongoing Improvement. Material delivered during the lectures.
Assessment methods and criteria:
The assessment is based on the group work.
Grading:
The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Professor Pekka Kess
Working life cooperation:
The group work is done in cooperation with case companies.
Other information:
Substitutes course 555322S Production Management.

080919S: Project in Health Technology, 5 - 10 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Health Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Jämsä, Timo Jaakko

Opintokohteen kielet: Finnish

ECTS Credits:
10 ECTS credit points / 270 hours of work.
Language of instruction:
Finnish / English
Timing:
The course can be taken in autumn or spring semester, or during the summer period. It is recommended to take this course at the 3rd spring semester.
Learning outcomes:
Upon completion of the course, the student will be able to solve a research or other type of problem and report it in writing and by oral presentation.
Contents:
Performing a small project example on reseach topic or development.
Mode of delivery:
Independent work.
Learning activities and teaching methods:

The student participates in a research project within or outside the university. The student prepares a personal project plan according to separate specifications. At the end of the project, the student prepares a written research report and presents it in a seminar. In addition, the student participates in at least two other seminar sessions.
Target group:
Degree students of the Biomedical Engineering (primarily for students from Medical faculty).
Recommended optional programme components:
The course is an indpendent entity.
Assessment methods and criteria:
Students makes and presents a project plan, participates in seminar, and reports project results in written report and oral presentation.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course utilizes grading scale pass/fail.
Person responsible:
Maarit Kangas
Working life cooperation:
Project can be commissioned by a company or pther organisation. Topic and supervision is agreef together with the client.

521097S: Wireless Measurements, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Saarela

Opintokohteen kielet: English

Leikkaavuudet:

521114S	Wireless Measurements	4.0 op
521114S-01	Wireless Measurements, exam	0.0 op
521114S-02	Wireless Measurements, exercise work	0.0 op

ECTS Credits:
5 ECTS credits / 128h
Language of instruction:
In Finnish or in English if two or more foreign students participate.
Timing:
Period 3.
Learning outcomes:
1. can tell and justifying argument the benefits and challenges of using wireless measurement solutions
2. can apply the most important standards when designing wireless measurement solutions
3. can apply wireless technologies in industrial, traffic, environmental, home and healthcare measurements
Contents:
Basics of wireless measurement technologies and standards, wireless sensors and sensor networks, wireless building and smart home applications, wireless measurement applications in traffic, wireless environmental measurements and wireless human health monitoring.
Mode of delivery:
Face-to-face teaching.
Learning activities and teaching methods:
Lectures 22h. Seminars 6-12h depending on the number of students participating the course. The students prepare seminar presentations about contemporary topics selected by themselves or proposed by the teacher and give 15-20 minutes presentation to other students in the seminars.
Target group:
Master level students regardless of master's programme.
Prerequisites and co-requisites:
No prerequirements, but basics of measurements systems are recomended.
Recommended optional programme components:
The course replaces previous courses with same name, but different credits and code.
Recommended or required reading:

Lecture notes and seminar reports is Optima.
Assessment methods and criteria:
The course is passed with a written final exam (70 %) and a contemporary seminar (30 %).
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Grade is on numerical scale 1-5.
Person responsible:
Juha Saarela
Working life cooperation:
No.

580213S: Master's Thesis in Biomedical Engineering, 30 op

Voimassaolo: 01.08.2013 -

Opiskelumuoto: Advanced Studies

Laji: Diploma thesis

Vastuuyksikkö: Health Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Jämsä, Timo Jaakko

Opintokohteen kielet: English

ECTS Credits:
30 ECTS credit points / 810 hours of work
Language of instruction:
Finnish or English
Timing:
Master studies
Learning outcomes:
The student can independently solve a research problem, and describe and solve it. The student can report the work in written form according to the scientific report principles.
Contents:
Research project in the field of medical & wellness technology and writing of the thesis.
Mode of delivery:
Independent work
Learning activities and teaching methods:
Thesis can be made at different research groups of the university or in industry or health care system. The student writes the thesis independently supported by the supervisor. The topic and contents should be discussed with the professor beforehand.
Target group:
Master Students of Biomedical Engineering or Medical Technology
Recommended optional programme components:
Connected with Study plan 5 ects
Assessment methods and criteria:
Writing the thesis
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Professor Timo Jämsä
Working life cooperation:
Thesis can be made for an organization outside the university
Other information:
It is recommended that before starting the Master’s Thesis student has completed about 60 credits from master studies.

580211S: Maturity Test, 0 op

Voimassaolo: 01.08.2003 -

Opiskelumuoto: Advanced Studies

Laji: Course
Vastuuyksikkö: Health Sciences
Arvostelu: 1 - 5, pass, fail
Opettajat: Jämsä, Timo Jaakko
Opintokohteen kielet: Finnish

ECTS Credits:
0 ECTS credit points
Language of instruction:
Finnish / Swedish ior English
Timing:
After completion of Master's Thesis

Learning outcomes:
The student can produce mature text in popular form of the research field and thus show ones familiarity to the field
Contents:
Depends on the topic of the thesis
Mode of delivery:
Literary work
Learning activities and teaching methods:
Takes place after master's thesis. Written based on a given topic considering the thesis.
Target group:
Master Students of Biomedical Engineering or Medical Technology

Recommended optional programme components:
Will be written after the Master's Thesis has been submitted for a review.

Assessment methods and criteria:
Writing the Maturity test or the abstract of the Master's Thesis in the student's native language Finnish or Swedish. If the student's native language is another than Finnish or Swedish the Faculty will define separately the requirements for the language test.
Read more about assessment criteria at the University of Oulu webpage.

Grading:
Pass or fail. The contents will be assessed by the person responsible. If the student has not made the maturity test as part of the bachelor degree, the language will be assessed by a teacher of the Languages and Communication, University of Oulu Extension School.

Person responsible:
Professor Timo Jämsä
Other information:
If the student has not made the maturity test as part of bachelor's degree, the maturity test also presents the language skills in Finnish or Swedish.

Tutkintorakenteisiin kuulumattomien opintokokonaisuuksien ja -jaksojen kuvaukset

080923S: Physics in Radiation Therapy, 5 op

Voimassaolo: 01.08.2017 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Health Sciences
Arvostelu: 1 - 5, pass, fail
Opettajat: Juha Nikkinen
Opintokohteen kielet: English

ECTS Credits:
5 ECTS credit points / 135 hours of work
Language of instruction:
English
Timing:
The course is held in the spring semester, during period IV in uneven years. It is recommended to complete the course during master studies.
Learning outcomes:
Upon completion of the course, the student will be able to:

- explain the common radiotherapy techniques
- explain the physical and biological factors connected to the dose planning
- explain the dosimetric and radiation protection factors in radiotherapy

Contents:
The course introduces students to basic physics of radiotherapy equipment for the hospital. Topics to be included: a linear accelerator dosimetry, radiation protection, dose planning, quality assurance, radiation physics and biology in radiotherapy point of view in addition to internal radiation therapy methods.
Mode of delivery:
The course is delivered as face-to-face teaching. It also includes independent work.
Learning activities and teaching methods:
The methods of course implementation vary.
Approximately course contains lectures 16h, demonstrations 4-8h, written report and independent work 111-115h. Course contains written report and exam.
Target group:
Master Students in Biomedical Engineering and Physics, and other interested Master level students.

Prerequisites and co-requisites:
The required prerequisite is the completion of the following course or corresponding information to enrolling for the course: 080920S Diagnostic Imaging 5 credits.
Recommended or required reading:
F. M. Khan: The Physics of Radiation Therapy, 4th ed., Wolters Kluwer, Lippincott Williams & Wilkins, 2010.

Assessment methods and criteria:
Participating to lectures and demonstrations (80% participation). Written report about demonstrations. Exam.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course utilizes numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Docent Juha Nikkinen
Working life cooperation:
Student will visit different units of the hospital.