FBMM COURSES DURING AUTUMN SEMESTER

Title of module	**744635S Protein production and analysis I**
Module - coordinator	**Lloyd Ruddock**

Credit points	5	**Semester(s) in which the module is taught**	1
Contact hours		**Workload**	133 hours

Lecturer(s)	Lloyd Ruddock
Type of teaching	Face to face teaching 42 contact hours (includes 8 hours of problem solving classes plus other exercises)
Relation to curriculum	Target group MSc students in Biochemistry
Recommended prerequisites	
Aims	
Learning outcome	Upon successful completion students are able to: • tell and discuss the relevance of protein structure, including post-translational modification, to protein function • assess the techniques available to purify proteins and to study protein function and an appreciation of the applications and limitations of these techniques • interpret a wide range of biochemical data and to solve problems relating to the interpretation of data relating to protein function and basic structural characterization
Contents of module	This module provides an overview of recombinant protein production and analysis. Topics covered include an overview of DNA technology, PCR, cloning, mutagenesis, protein production, purification, enzyme catalysis, protein structure analysis, and protein folding.
Study and examination requirements; Forms of examination	Continuous assessment (problem solving exercises)
Literature	

Title of module	**744627S Molecular biology II**
Module - coordinator	**Elitsa Dimova**

Credit points	5	**Semester(s) in which the module is taught**	1
Contact hours		**Workload**	133 hours

Lecturer(s)	Elitsa Dimova, Anatoliy Samoylenko
Type of teaching	Face to face teaching 18 h lectures, plus student presentations
Relation to curriculum	Target group: Major students
Recommended prerequisites	The course is designed for MSc students familiar with DNA organization, gene structure & genetic concepts (ORF, codon, heterologous and homologous recombination).
Aims	
Learning outcome	After the course students are able to: • describe the general features of DNA manipulating enzymes and CRISPR-Cas9 • design (on paper or in silico) oligonucleotides for PCR amplification • design and set up restriction digests and ligation reactions in order to carry out basic and advanced cloning procedures • analyze experimental results from basic cloning procedure • use basic datasets and basic online bioinformatics tools for genetic engineering
Contents of module	This module provides a "real-life" approach to practical molecular biology, including DNA cloning strategies, site directed mutagenesis, generation of transgenic mice, etc. It comprises concept overview lectures, complex problem solving based exercises and includes written reports and student presentations. Attendance of the course is required.
Study and examination requirements; Forms of examination	This course utilizes continuous assessment based on problem solving based exercises, written reports, student presentation, and crossword solutions. All tasks should be passes by minimum of 60%.
Literature	

Title of module	**744640S Data mining and data-based models**
Module - coordinator	**Valerio Izzi**

Credit points	5	**Semester(s) in which the module is taught**	1
Contact hours		**Workload**	133 hours

Lecturer(s)	Valerio Izzi
Type of teaching	Web-based self-study / teaching (local face-to-face teaching will be arranged if the situation allows) 30h of exercise groups, 105h self-studying in the web
Relation to curriculum	
Recommended prerequisites	Esitietovaatimukset It is recommended that this course is taken together or after the course Bio-data and before eventual courses on data management. Molecular biology and Biochemistry courses should be taken before this.
Aims	
Learning outcome	After completing the course, students should be able to: • understand, find and mine biomedical data sources • devise strategies for the mining of aggregated and sparse data • identify static and responsive databases and interact with them • perform basic data mining operations, including ontological enrichments and pathway/network analysis • evaluate the quality of data and their usability in further contexts
Contents of module	Sources and types of biomedical data, aggregated vs. sparse data, use of data for hypothesis generation and validation
Study and examination requirements; Forms of examination	The course is completed by passing all learning assignment and exercises
Literature	

Title of module	**744637S Introduction to microfluidics and lab-on-a-chip devices**
Module - coordinator	Caglar Elbuken

Credit points	5-7	**Semester(s) in which the module is taught**	1
Contact hours		**Workload**	133-187 hours

Lecturer(s)	Caglar Elbuken
Type of teaching	24 h lectures + laboratory visit + optional laboratory (10 h)
Relation to curriculum	Target group: BSc and MSc level students
Recommended prerequisites	
Aims	
Learning outcome	Understanding biology requires familiarity to two substances: water and air. Hence, understanding the behavior of fluids is fundamental to life. In this course, we cover the fundamentals of fluidics at small scale and apply those concepts to several applications such as digital detection systems and organ-on-chip devices. The course does not require a deep physics or mathematics background and tailored as an introductory course for biochemistry and medicine students. Point of care diagnostic devices and state-of-the-art microfluidic devices and techniques are introduced. During laboratory sessions, students practice with microfluidic tools and devices.
Contents of module	Microfluidics has emerged as an enabling field through joint efforts of researchers from different disciplines. The application of fluidic concepts to micro/nanosystems yielded lab-on-a-chip (LOC) devices as a solution for several scientific challenges. Today, LOC systems are forming the backbone of several biochemical analysis methods including biosensors, organ-on-chip systems and point-of-care diagnostic devices. The goal of this course to cover the basics and the latest developments in the field of microfluidics and their application areas in sensing and diagnostics. The first half of the course is intended to cover the fundamental fluidic concepts. The second half of the course covers the application areas of microfluidic, e.g. biosensors, lateral flow kits, organ-on-chip devices and next generation sequencing devices. For students interested in a hands-on experience, an extended module with multiple laboratory sessions is available (option-2). The lecture is a pre-requisite to take the laboratory practice session. Laboratory part is for students interested in getting their hands wet and have a feel for microfluidic circuits. Lab is composed of three successive sessions that build on each other. Group work is preferable. Groups of 3-4 students are ideal. First, the laboratory will cover the basics of generating flow, measuring flow rate and making simple fluidic devices/connectors/adaptors (lab 1). In the following exercise (lab 2), the goal is to analyze a given microfluidic circuit, specifically a Y-shape microflow mixer, and evaluate its performance and flow characteristics using computational tools, to build it and to test its mixing

	performance. In the last module (lab 3) the goal is to work on high throughput droplet microfluidic systems.
Study and examination requirements; Forms of examination	Lecture notes, articles and online materials provided through Moodle page.
Literature	

Title of module	**744636S Protein production and analysis II**
Module - coordinator	Rajaram Venkatesan

Credit points	5	**Semester(s) in which the module is taught**	1
Contact hours		**Workload**	133 hours

Lecturer(s)	Rajaram Venkatesan
Type of teaching	Face to face teaching 14 contact hours +80 hours of lab
Relation to curriculum	Target group MSc students in Biochemistry. Course is not allowed to students who have taken Protein chemistry I
Recommended prerequisites	PPA I or equivalent. This course cannot be taken by people who have done Protein Chemistry I (740364A)
Aims	
Learning outcome	Upon successful completion students are able to: • Tell and discuss the relevance of protein structure, including post-translational modification, to protein function • Assess the techniques available to purify proteins and to study protein function and an appreciation of the applications and limitations of these techniques • Interpret a wide range of biochemical data and to solve problems relating to the interpretation of data relating to protein function and basic structural characterization
Contents of module	This module provides an overview of recombinant protein production and analysis. It includes mainly problem-solving sessions addressing the relevance of protein structure and function and laboratory experiments concerning protein purification, enzyme kinetics, protein crystallization and protein analysis by immunoprecipitation-western blotting. Attending laboratory exercises and submitting lab reports are obligatory.
Study and examination requirements; Forms of examination	Problem solving session -as discussion groups Lab experiments Lab reports
Literature	

Title of module	**743665S Molecular, cell biological and genetic aspects of diseases**
Module - coordinator	Hamish Pegg

Credit points	5	**Semester(s) in which the module is taught**	1
Contact hours		**Workload**	133 hours

Lecturer(s)	
Type of teaching	Self-study online course with materials and exercises provided on an electronic learning platform.
Relation to curriculum	Target group MSc / Molecular medicine
Recommended prerequisites	Adequate knowledge on basic biochemistry and cellular and molecular biology
Aims	
Learning outcome	Upon completion the student should be able to: • based on biogenesis, structure and function of the key cell organelles discuss their role in pathology and describe organelle-specific disease mechanisms • describe typical inherited diseases in terms of their occurrence, biochemistry behind their origin, and their analysis and treatment possibilities
Contents of module	The course provides knowledge on structure and function of organs and organelles and diseases associated with them. Some specific topics may change due to availability of expert teachers or emerging hot topics, and may be such as mitochondria, peroxisomes, endoplasmic reticulum, the Golgi apparatus, myelin, inherited diseases, Finnish disease heritage, gene defects, detection and correction with gene therapy.
Study and examination requirements; Forms of examination	Each topic forms one section of the course and contains exercises, like e.g., multiple choice questions in the form of mini-exams. Points gathered from such exercises constitute a continuous assessment for the final grade.
Literature	

Title of module	**743664S Hypoxia response pathway - molecular mechanisms and medical applications**
Module - coordinator	Peppi Karppinen

Credit points	5	**Semester(s) in which the module is taught**	1
Contact hours		**Workload**	133 hours

Lecturer(s)	Peppi Karppinen, Thomas Kietzmann, Johanna Myllyharju
Type of teaching	Face to face teaching 14 h lectures, 22 h seminars (obligatory) and 4 h round table discussions (obligatory).
Relation to curriculum	Target group MSc / Molecular medicine
Recommended prerequisites	
Aims	
Learning outcome	Upon completion the student should be able to: • Present and discuss the basic mechanisms involved in regulation of oxygen homeostasis on cellular, tissue, organ/organism level • To integrate/adapt regulation of oxygen homeostasis under normal physiological conditions to pathological situations • Display an understanding on how the basic biochemical knowledge translates from the bench to the bedside • Understand the meaning of translational research
Contents of module	General physiology of hypoxia, Hypoxia response in bacteria, Hypoxia response in yeast, Hypoxia-inducible factors (HIFs), Regulation of HIFs on the transcriptional, translational and post-translational level, Conditions related to hypoxia response (erythropoiesis and iron regulation, angiogenesis and metabolism), Experimental models to study hypoxia, HIFs and HIF prolyl 4-hydroxylases as drug targets. Lecture topics may vary.
Study and examination requirements; Forms of examination	Seminars and exam. 1/5 of the grade is based on the seminar presentation and opponent work and 4/5 on the exam in which the student must display an understanding on how the basic biochemical knowledge translates from the bench to the bedside.
Literature	

Title of module	**747616S Biochemical methodologies II**
Module - coordinator	Ulrich Bergmann

Credit points	10	**Semester(s) in which the module is taught**	1
Contact hours		**Workload**	266 hours

Lecturer(s)	Ulrich Bergmann, Lloyd Ruddock, Hongmin Tu, Steffen Ohlmeyer
Type of teaching	Face to face teaching 120 h lab., including pre-lab lectures plus exercises. For laboratory period a personal time table will be created for every student. Each student will spent about 1 full day and 5 half day´s slots in the lab, plus one week proteomics lab with workload from 2h to full day.
Relation to curriculum	Target group Compulsory for M.Sc. in Protein Science and biotechnology
Recommended prerequisites	Protein production and analysis I (744635S) and Protein production and analysis II (744636S) OR Protein chemistry I (740364A)
Aims	
Learning outcome	Upon successful completion students are able to: • describe the theoretical basis of the main biochemical analysis methods for proteins • use the different instruments • describe the potential of the different analytical techniques and develop strategies for addressing specific questions in protein & proteome-analysis • integrate data from multiple sources and evaluate it critically • understand why control experiments are essential for interpreting data and for scientific conclusions
Contents of module	During this module students will analyze their own protein samples. The course will cover principles and practical applications of some of the more advanced methodologies used in practical biochemistry, including chromatography, fluorescence spectroscopy, stopped flow analysis of enzymatic reactions, circular dichroism, surface plasmon resonance, micro-calorimetry, mass spectrometry, and proteomics based on 2D electrophoresis and LCMS. For assessement each student has to write four research reports in the style of a scientific publication. Attendance is compulsory. The course has limited enrollment for 22 students.
Study and examination requirements; Forms of examination	Four reports written in style of a scientific publication

Literature	

Title of module	**744641S Bio-data**
Module - coordinator	Valerio Izzi

Credit points	5	**Semester(s) in which the module is taught**	1
Contact hours		**Workload**	133 hours

Lecturer(s)	Valerio Izzi
Type of teaching	Web-based self-study / teaching (local face-to-face teaching will be arranged if the situation allows) 30h of exercise groups, 105h self-studying in the web
Relation to curriculum	Target group 2nd year (and beyond) students of biochemistry, 2nd year students of computer science and engineering, electrical engineering, medical and wellness technology
Recommended prerequisites	It is recommended that this course is taken together or after the course Data mining and data-based models and before eventual courses on data management. Molecular biology and Biochemistry courses should be taken before this.
Aims	
Learning outcome	After completing the course, students should be able to handle different types of biomedical data (e.g., RNAseq, scRNA-seq, ChIPseq, etc.), processing them through suitable pipelines both on local machines and cloud services
Contents of module	Typical types of biomedical data “omics big data”, pipelines and services for data processing, advantages and pitfalls of different omics and their associated data types and processing pipelines, hands-on data processing
Study and examination requirements; Forms of examination	The course is completed by passing all learning assignment and exercises
Literature	

Title of module	**743662S Extracellular matrix**
Module - coordinator	Ritva-Leena Heljasvaara

Credit points	3-5	**Semester(s) in which the module is taught**	1 (lectures) -2 (labs)
Contact hours		**Workload**	80-133 hours

Lecturer(s)	Ritva-Leena Heljasvaara
Type of teaching	Classroom/on-site teaching (attendance is not required). Teaching language is English. 20-23 h lectures, 4-6 h project work and 35 h laboratory work.
Relation to curriculum	Target group MSc, Molecular medicine
Recommended prerequisites	
Aims	
Learning outcome	Upon successful completion students are able to: • Describe the structure and key components of the mammalian extracellular matrix (ECM) • Describe the main significance of the ECM for cell and tissue function • Outline the roles of ECM in inherited connective tissue disorders and in other common diseases • Identify connective tissue and some of its components in tissue samples using various staining protocols (laboratory work). • Summarize background knowledge of ECM sufficiently to feel comfortable in undertaking a MSc or PhD research project in the ECM field
Contents of module	Besides including basic background knowledge on the ECM, the course will highlight the ECM-related topics that are currently being investigated at the Faculty of Biochemistry and Molecular Medicine. Orientation to mouse and cell models of ECM molecules will form a crucial part in teaching. Contents of lectures (may vary): Collagens and collagen-related hereditary diseases; Basement membranes; Pericellular matrix of the vasculature; Integrins and other ECM receptors; Elastic fibres; Stem cell microenvironments; Fibrosis; ECM in cancer; ECM glycproteins and proteoglycans; Biomaterials. The laboratory part has limited enrollment for 18 students. It is also possible to take a shorter course (3 ECTS), including lectures, an exam and an alternating written or oral exercise (e.g. problem-based learning).
Study and examination requirements; Forms of examination	Final exam and an approved written or oral exercise (e.g. problem-based learning) and/or a laboratory course. The course parts affect the final grade as follows: 5 ECTS: Exam 50%, Laboratory course 30%, Exercise 20% 3 ECTS: Exam 70%, Exercise 30% 60% of the maximum score entitles a grade 3 70% of the maximum score entitles a grade 4 80% of the maximum score entitles a grade 5

Literature	

Title of module	**747614S Macromolecular X-ray crystallography**
Module - coordinator	Lari Lehtiö

Credit points	5	**Semester(s) in which the module is taught**	1
Contact hours		**Workload**	133 hours

Lecturer(s)	Lari Lehtiö
Type of teaching	Face to face teaching 35 h lectures, 52 h exercises, project work and a research report
Relation to curriculum	Target group: MSc / Protein science and biotechnology
Recommended prerequisites	Protein chemistry I or Protein production and analysis or equivalent
Aims	
Learning outcome	After completion of this course students are able to: • Discuss the key aspects of protein crystallization methods and interpret the results • Describe the diffraction of X-rays and the importance of crystal symmetry • Describe the importance of the Fourier transform method in the structure determination • Describe the phase problem and tell the methods to solve it • Apply knowledge on protein chemistry to refinement of a crystal structure • Judge the quality of a protein structure
Contents of module	The course will describe the principles of X-ray diffraction theory and practice. It includes a hands on project done throughout the course on protein crystallization, data collection, solving and refinement of the protein structure and validation of the model. Following topics will be covered during the lectures and practicals: crystallisation theory, symmetry of crystals, handling of crystals, data collection, diffraction pattern and the reciprocal lattice, the phase problem, molecular replacement, isomorphous and anomalous differences, structure refinement and validation. Attendance to the lectures and exercises is compulsory. The course has limited enrollment for 18 students
Study and examination requirements;	Continuous assessment, research report, no exam.

Forms of examination	
Literature	

Title of module	**744628S Orientation to research work**
Module - coordinator	Alexander Kastaniotis

Credit points	0-20	**Semester(s) in which the module is taught**	1 and 2
Contact hours		**Workload**	0-533 hours

Lecturer(s)	
Type of teaching	Independent work
Relation to curriculum	Target group MSc in Protein Science and biotechnology or MSc in Molecular Medicine
Recommended prerequisites	
Aims	
Learning outcome	After this course student has gained experience of practical work done in research groups. Student is able to: • demonstrate goal-oriented teamwork • apply methods used in proper environment • discuss the practical work done and reflect his knowledge
Contents of module	This module provides an introduction to research work via the active integration of students into research groups and/or via one to two week advanced practical courses. The integration into groups can be either full-time or part-time research work, with 5op being awarded for each three full-time weeks equivalent worked. Max 10 credits (six full weeks) can be done in one research group. The research groups do not need to be in the Faculty of Biochemistry and Molecular Medicine, University of Oulu, but advance permission should be sought if the research group is not part of the University of Oulu.
Study and examination requirements; Forms of examination	Research work
Literature	

Title of module	**744629S Orientation to biochemical work**
Module - coordinator	Alexander Kastaniotis

Credit points	0-20	**Semester(s) in which the module is taught**	1 and 2
Contact hours		**Workload**	0 - 533 hours

Lecturer(s)	
Type of teaching	Independent work
Relation to curriculum	Target group MSc in Protein Science and biotechnology or MSc in Molecular Medicine
Recommended prerequisites	
Aims	
Learning outcome	After this course student has gained experience of practical work done in non-research group environment. Student is able to: • demonstrate goal-oriented teamwork • apply methods used in proper environment • discuss the practical work done and reflect his knowledge
Contents of module	This module provides an introduction to non-research work in companies or other suitable environment. The work can be either full-time or part-time work, with 5op being awarded for each three full-time weeks equivalent worked. Max 10 credits (six full weeks) can be done in one place. Each placement must be agreed in advance with the responsible person.
Study and examination requirements; Forms of examination	Biochemical work
Literature	

FBMM COURSES DURING SPRING SEMESTER

Title of module	**Virology**
Module - coordinator	Thomas Kietzmann

Credit points	5	**Semester(s) in which the module is taught**	2
Contact hours		**Workload**	133 hours

Lecturer(s)	Thomas Kietzmann
Type of teaching	Face to face teaching 24 h lectures and student presentations in seminars
Relation to curriculum	Target group Major students
Recommended prerequisites	
Aims	
Learning outcome	Upon successful completion students are able to: • discuss the major groups of viruses and their infection and replication mechanisms • present and discuss characteristic features of specific viruses and their relation to pathogenesis and immunity • describe diagnostic methods and antiviral therapy
Contents of module	The course covers basic aspects of virology. The main emphasis will be made on viral infection, replication, transcription, proteinsynthesis, virological diagnostics, infection kinetics, defense against viruses, ways of infection, vaccination, and antiviral therapy. The course involves lectures 10h, 10h seminars, and reading literature with which the students should be able to recapitulate major aspects of the teached material in 5-7 min presentations.
Study and examination requirements; Forms of examination	Final exam
Literature	

Title of module	**747617S Biochemistry and biotechnology of protein folding**
Module - coordinator	Lloyd Ruddock

Credit points	5	**Semester(s) in which the module is taught**	2
Contact hours		**Workload**	133 hours

Lecturer(s)	Lloyd Ruddock
Type of teaching	16 contact hours of lectures and seminars
Relation to curriculum	Target group M.Sc. in Protein science and biotechnology and exchange students
Recommended prerequisites	Protein chemistry I (740364A) or Protein production and analysis I (744635S) or Protein production and analysis (747618S) or equivalent
Aims	
Learning outcome	Upon successful completion students are able to: • present and discuss issues presented in the primary literature on a variety of aspects of protein folding. • display an understanding of the theoretical and practical implications of in vivo, in vitro and in silico studies on protein folding and the integration of results. • demonstrate the ability to interpret a wide range of data from multiple sources, to critically evaluate and contextualize this data and to solve problems relating to interpretation.
Contents of module	This module provides an introduction to protein folding in vivo and in vitro. Topics covered include protein folding and quality control in the endoplasmic reticulum, mechanisms regulating protein folding including the unfolded protein response, the catalysis of native disulphide bond formation, the biochemistry of molecular chaperones and the role of molecular chaperones and protein folding catalysts in other cellular events. The application of this knowledge to biotechnology will also be discussed.
Study and examination requirements; Forms of examination	The module is assessed based on reports prepared on individual topics and on participation in the seminars.
Literature	

Title of module	**743666S Introduction to immunology**
Module - coordinator	Jane Chen

Credit points	5	**Semester(s) in which the module is taught**	2
Contact hours		**Workload**	133 hours

Lecturer(s)	Jane Chen
Type of teaching	Lectures (14 h), a written home exercise, and a final exam
Relation to curriculum	Target group: Major and minor subject undergraduates
Recommended prerequisites	Molecular biology I, Protein chemistry I and Cellular biology, or equivalent basic molecular biology, protein chemistry and cell biology studies.
Aims	
Learning outcome	After the course students will be able to understand, identify, analyze and apply essential concepts of cellular and molecular components and mechanisms of immunology, and integrate their previous knowledge of molecular and cellular biology and protein chemistry with immunology and immunobiochemistry instances
Contents of module	The course handles the basis of immunology, covering cells and mechanisms of innate and adaptive immune responses (inflammation, anti-microbial and anti-viral defenses, T-cell activation, antibody production, etc.). The course also offers insights into the physiopathology of the immune responses (chronic inflammation, allergy, autoimmune disorders, transplantation and cancer) and the clinical (immunotherapy, cytokine therapy, etc.) and industrial (monoclonal antibodies, ELISA and immunodiagnostics, etc.) applications of immunological processes.
Study and examination requirements; Forms of examination	Home exercise, final exam
Literature	

Title of module	**747615S Introduction to structure-based drug discovery**
Module - coordinator	Lari Lehtiö

Credit points	5	**Semester(s) in which the module is taught**	2
Contact hours		**Workload**	133 hours

Lecturer(s)	Lari Lehtiö
Type of teaching	Face to face and web based teaching 12 h Lectures, 48 h practicals and group work, 9 h student presentations and discussions
Relation to curriculum	Target group: MSc / Protein science and biotechnology
Recommended prerequisites	BSc in biochemistry or a related subject, Protein Chemistry I or Protein production and analysis
Aims	
Learning outcome	After completion of this course student should be able to: • Find and analyze a protein structure of interest from databases from the point of view of drug discovery • Critically assess a quality of an experimental protein-small molecule complex structure • Discuss the process of creating a virtual small molecule library • Describe the commonly used computational methods for screening of small molecule libraries against a protein target • Critically judge the results of the computational screening
Contents of module	The course will consist of assignments, lectures and a project work carried out during the course in study groups. Groups will present their project plans and the results. All students will give feedback and share ideas during the discussions. The project carried out during the course will be supported by lectures and discussions. The final mark comprises marks from continuous assessment, active participation to the group work and oral exam. Attendance to some parts of the course is compulsory. The course has limited enrollment for 18 students.
Study and examination requirements; Forms of examination	Continuous assessment, presentations, oral exam
Literature	

Title of module	**743668S Tumor cell biology**
Module - coordinator	Thomas Kietzmann

Credit points	5	**Semester(s) in which the module is taught**	2
Contact hours		**Workload**	133 hours

Lecturer(s)	Thomas Kietzmann
Type of teaching	Face to face teaching 20 h lectures and student presentations upon request in seminars
Relation to curriculum	Target group MSc / Molecular medicine
Recommended prerequisites	
Aims	
Learning outcome	Upon successful completion students are able to: • name, list and discuss the major aspects including formation of a tumor cell • present, desribe and discuss characteristic aspects of oncogenes and tumor suppressor genes • use methods to study, examine and to analyse tumor genesis and tumor progression
Contents of module	The course covers basic aspects of the main pathways inducing formation of a tumor. The main emphasis will be made on modes of carcinogenesis, tumor metabolism, the formation of oncogenes, the action of tumor suppressor genes and the induction of tumors by viruses. The course covers also aspects of tumor diagnostics and therapy. The course involves lectures 20h with included 10h seminars, and reading literature with which the students should be able to recapitulate major aspects of the teached material in 5-7 min presentations.
Study and examination requirements; Forms of examination	Final exam
Literature	

Title of module	**743663S Developmental biology, stem cells and tissue engineering**
Module - coordinator	Seppo Vainio

Credit points	5	**Semester(s) in which the module is taught**	2
Contact hours		**Workload**	133 hours

Lecturer(s)	Seppo Vainio
Type of teaching	Face to face teaching 16 h lectures and seminars, 3 assessments and 25 h laboratory work. Lectures (100% attendance), assessments and laboratory work are compulsory.
Relation to curriculum	Target group MSc / Molecular medicine
Recommended prerequisites	
Aims	
Learning outcome	Upon completion of the course the student have obtained an overview of how the development of tissues and organs is regulated and executed via developmental gene regulation and developmental programs behind morphogenesis. Students will become familiar with the classical and modern experimental embryological techniques during lectures and also with hands-on laboratory work.
Contents of module	The course provides knowledge on use of various model organisms, basic information about embryology and early developmental mechanisms and signaling molecules. Introduces detailed description of development of few organ systems and provides knowledge about classical and novel study techniques to discover new developmental ques. The course has limited enrollment for 16 students. Lecture part (2 credits) is open for all students
Study and examination requirements; Forms of examination	Continuous assessment, no exam
Literature	

Title of module	**744639S Biosensors and introduction to microfabrication**
Module - coordinator	Caglar Elbuken

Credit points	5-7	**Semester(s) in which the module is taught**	2
Contact hours		**Workload**	133-187 hours

Lecturer(s)	Caglar Elbuken
Type of teaching	Face to face teaching 24 h lectures (12x2 h) + laboratory visits (3 h) + optional hands-on lab sessions (10 h)
Relation to curriculum	Target group: BSc and MSc level students
Recommended prerequisites	Introduction to microfluidics and lab-on-a-chip devices (740387A/744637S) is a pre-requisite for this course.
Aims	
Learning outcome	The students are expected to learn common types of biosensors, their operating principles, the common fabrication types. The course will provide the background and the jargon required to follow the leading journals of the field such as Biosensors and Bioelectronics, Analytical Chemistry. Basics of electrochemistry and optics are also covered for studying electrochemical and optical biosensors. Fabrication techniques are presented together with a visit to University of Oulu cleanroom. The laboratory infrastructure used for biosensor microfabrication and characterization are introduced. The course also involves a series of laboratory sessions for hands-on practice with electrochemical sensors.
Contents of module	Biosensors have a wide field of use and serves not only for end-user analysis but also for biochemical process characterization. There are several types of biosensors that use various operating principles. This course builds on the introductory fluidics course (740387A/744637S) and introduces engineering concepts of biosensors and microfluidic systems. The course covers functioning principles of major types of biosensors such as electrochemical, optical and mass-based biosensors and also discusses methodologies required to fabricate these structures. Cleanroom micromanufacturing techniques are explained. The course discusses engineering concepts governing the design principles of such fully integrated biosensor systems. Optional laboratory is for students interested in getting their hands dirty. This module is composed of three successive sessions that build on each other. Group work is preferable. Groups are 3-4 students are ideal. (will be decided depending on lab infrastructure, availability of equipment and class size), Laboratory sessions aim for understanding electrochemical biosensors and the use of common electrochemical sensing protocols.
Study and examination requirements;	Homework assignments, term project, laboratory reports

Forms of examination	
Literature	

Title of module	**740397A Mathematics for biomedical data analysis**
Module - coordinator	Rijuta Lamba

Credit points	5	**Semester(s) in which the module is taught**	2
Contact hours		**Workload**	133 hours

Lecturer(s)	Rijuta Lamba
Type of teaching	Face-to-face teaching. Lectures (14h), compulsory exercises (6h) and independent work.
Relation to curriculum	Target group: 2nd year (and beyond) students of biochemistry, 2nd year students of computer science and engineering, electrical engineering, medical and wellness technology.
Recommended prerequisites	
Aims	
Learning outcome	After completing the course, students should be able to: • Acquire an understanding of available Biomedical Databases and different types of data. • Acquire a basic understanding of various statistical concepts required to perform exploratory data analysis on biological data. Understand the importance of probability and distribution when dealing with data and understand the power of hypothesis testing and significance for big- data • Understand the basics of Algorithms including the logic behind elementary data-structure, time complexity and how big-data challenges concerning space and efficiency can be dealt with.
Contents of module	• Introduction to Data Repositories and Biomedical Data • Basics of Probability- Revision of fundamental concepts. Mathematics of Probability, Principles of counting • Visualising Probability using tree diagrams. Conditional Probability, Bayes Theorem and Joint Probability

	• Hypothesis Testing, Sampling Distribution, Maximimum likelihood and p-values Significance and a comparative analysis of the application of the various statistical distributions • Introduction to Algorithms- Elementary Data structures • Understanding Time complexity in Algorithms • Understanding the basic algorithms behind data compression and preparing data for use – suffix arrays, suffix trees and the Burrows Wheeler transform
Study and examination requirements; Forms of examination	Active participation in lectures and exercises.
Literature	

Title of module	**747613S In silico methodologies in biochemistry and molecular medicine**
Module - coordinator	Andre Juffer

Credit points	5	**Semester(s) in which the module is taught**	2
Contact hours		**Workload**	133 hours

Lecturer(s)	Andre Juffer
Type of teaching	Hybrid (face-to-face and online) sessions for both lectures and workshops. 74 h contact sessions. Lectures, workshops, and student tasks.
Relation to curriculum	Target group MSc / Protein science and biotechnology
Recommended prerequisites	
Aims	
Learning outcome	After a successful completion of this course, students will have • Obtained an appreciation of the quantitative aspects of analyzing scientific data generated by sophisticated modeling and simulation tools. • Gained a basic understanding of applying various bioinformatics methods • Realized the potential of scientific computing for the study of the behavior of biological systems, in particular large biological macromolecules.
Contents of module	This course aims at emphasizing the quantitative aspects of scientific research. For this, the course contains two main components,

	• Searching and evaluating protein structural data from various databases using structural bioinformatics tools, • Using scientific computing (computer simulation) to study structural, dynamical, functional and thermodynamic properties of proteins and their interaction with other molecules. Students will learn to access biological databases, search and retrieve relevant data, analyze data in a meaningful manner, and link data and results obtained from different tools. A very brief introduction to metabases and data compilation is provided as well. Interaction studies are emphasized through proteomics-based bioinformatics. An overview of commonly employed modeling and simulation techniques will also be provided. These include atomic and coarse-grained molecular dynamics, Monte Carlo and Langevin (stochastic, Brownian) dynamics, dissipative particle dynamics, continuum electrostatics, statistical thermodynamics, protein modeling techniques, protein-ligand docking, protein-ligand affinity calculations, including the prediction of acid dissociation constants, and enzyme action (reaction mechanism). For the latter, a brief introduction to quantum mechanics will be provided.
Study and examination requirements; Forms of examination	Lectures and Workshop and assignments
Literature	

Title of module	**744632S Yeast genetics**
Module - coordinator	Alexander Kastaniotis

Credit points	5	**Semester(s) in which the module is taught**	2
Contact hours		**Workload**	133 hours

Lecturer(s)	Alexander Kastaniotis
Type of teaching	Face to face teaching 20 h lectures, 7 days practical, final exam and oral participation in course review session
Relation to curriculum	Target group Major students
Recommended prerequisites	
Aims	

Learning outcome	Upon successful completion students are able to: • tell a basic knowledge of yeast genetics and physiology • tell the basic principles of using the yeast model organism to address fundamental genetic and cell biological problems • (practical course) describe variety of genetic and molecular biology techniques commonly used to manipulate baker's yeast in the pursuit of biological questions
Contents of module	This course is an introduction to Saccharomyces cerevisiae as a model organism and the use of classical and molecular genetic approaches in this yeast to study basic cellular processes. We will also focus on genetic screens and selections designed to identify targets of interest. Aspects of transcriptional regulation will be discussed to provide a basic understanding for some of the screens and selections introduced. Performance in the course will be assessed by participation in the course review session at the beginning of each lecture (10% of total grade) and by a final written examination. The practical part of this is a block practical spread over four weeks running almost parallel to lecture course. It is designed to provide training in techniques and concepts commonly used in yeast genetics (streaking, spotting, mating, tetrad analysis, transformation, colony-color based assays, carbon source-dependent expression of genes, as well as generation and cloning of mutants). The course has limited enrollment for 16 people. It is also possible to only attend the lecture part of the course for 3.5 ECTS credits.
Study and examination requirements; Forms of examination	Course review sessions, final exam, experiment reports
Literature	

COURSES ON BACHELOR LEVEL

Title of module	**740366A Cellular Communication**
Module - coordinator	Thomas Kietzmann

Credit points	6	**Semester(s) in which the module is taught**	1
Contact hours		**Workload**	160 hours

Lecturer(s)	Thomas Kietzmann
Type of teaching	Face to face teaching 20 h lectures,32 h practicals
Relation to curriculum	Target group Major bachelor students
Recommended prerequisites	Cellular biology
Aims	
Learning outcome	Upon successful completion students are able to: • name, list and discuss the major intra- and intercellular signalling pathways • present, describe and discuss characteristic features of signalling pathways • describe how to study, examine and analyse signalling pathways
Contents of module	The course covers basic aspects of the main cellular signalling pathways. The main emphasis will be made on the signalling pathways involved in the action of various hormones, growth factors, lipid-derived signaling molecules, and their cell surface and intracellular receptors, intracellular second messengers and protein kinases and phosphatases. The course involves a 40 h practical course (+written reports) in which cultured cells are used as targets to visualize certain hormone or drug-induced signaling molecules, their interactions, and how these regulate e.g. normal cell growth and/or cell death in culture. Attendance at practical course is obligatory.
Study and examination requirements; Forms of examination	Laboratory practicals, final exam
Literature	