

## **Biochemistry 2016-2017**

Biochemistry is the study of life at the molecular level. Based on underlying chemical principles biochemists study the details of biological systems at both macro- and micro- scales in whole organisms, in cells, in the test tube and by structural and computational based analysis. Even the simplest living systems are extremely complicated, and comprise a vast array of interconnecting processes. These processes are said to be governed by our genes, the genetic code which makes us who and what we are. Genes are not everything though; the information encoded within them is converted into proteins and it is proteins that are the primary workers in the cell, playing fundamental roles in all aspects of biochemistry. Smaller molecules also play a key role, both through the complex cycles of metabolism, generating energy and essential cellular precursors from nutrients taken from the external world and by playing a role in modulating the function of genes and of proteins.

Sometimes cellular processes go wrong, due to genetic mutations or to external environmental factors or to chance events, and then disease states such as cancer, diabetes, cystic fibrosis or Alzheimer's arise. Only by understanding both the details of the underlying mechanisms of cellular action and the complex interplay of 30,000 gene products, a million different proteins and thousands of metabolites can these diseases be understood and effective treatments generated. These treatments may be small molecules, designed both to be targeted to the appropriate site within the body and to inhibit a specific cellular process through rational drug design, or they may be macromolecules, such as proteins produced on an industrial scale by the biotech industry, or there is the growing area of gene therapy, replacing a loss of function by introducing a working gene.

All of this, the understanding of the mechanisms of cellular action at a molecular level along with the rational design and production of therapeutic treatments, is the work of the biochemist.

### **Education**

The education of biochemists was changed in autumn 2005 to a new degree system across the EU. The first degree is a 3-year candidate degree (BSc, Bachelor of Science) followed by a 2-year master degree (MSc, Master of Science). The purpose of the change is to harmonize degrees in biochemistry in different universities, shorten graduating times and facilitate transfer of students between universities in different EU countries. The first MSc degree programmes under a new degree system started in autumn 2008. Since autumn 2007, the Department of Biochemistry has organized a Master Degree Programme in Protein Science and Biotechnology also for international students.

According to the decision of the University of Oulu Board of Directors the Department of Biochemistry has merged with the Department of Medical Biochemistry and Molecular Biology, currently part of the Institute of Biomedicine at the Faculty of Medicine to form a new Faculty of Biochemistry and Molecular Medicine (FBMM). The administrative merger started 1st January 2014 and the

physical merger occurred in summer 2014. The new faculty is located on the Kontinkangas campus. While the curricula of the BSc and MSc degrees will not change, the teaching arrangements have been changed. The first year and the autumn term of the second year of the BSc will continue to be taught on the Linnanmaa campus (laboratory parts of biochemistry courses on the Kontinkangas campus). The remaining studies in the BSc and all MSc courses offered by the new faculty will be taught on the Kontinkangas campus.

The Mission of the Faculty of Biochemistry and Molecular Medicine is based on the fact that current and high level teaching cannot be given without strong basic research. This can be seen in the operational principles of the faculty. Innovative specialists will be needed in the field. Teaching is seen as an entity where high quality basic and doctoral education, including post-doctoral training abroad, is a fundamental part of the faculty structure.

Post graduate training has an important role in the faculty. Research work starts at the end of MSc phase when a student is doing his Pro gradu project with research work towards a PhD being started after this. Many research groups of international level are operating in the faculty and about 90 PhD students are working here at present. Post graduate training involves high level training and is linked to clear research projects.

Most of the students who have graduated from the degree programme in biochemistry, University of Oulu are working in universities within research and teaching, while some are employed by industry, business or by different educational institutes for tasks in research, development, communication and management. One third of the graduated students have taken the licentiate degree and about one fifth have PhD degree. Most of the latter have spent a post-doctoral period abroad.

## **Studies**

Amanuensis Jari Heikkinen helps in matters related to studies. In questions concerning a single study module student can contact the responsible person of the course.

All courses and exams organized by faculty must be subscribed to via WebOodi (<https://weboodi.oulu.fi/oodi>) before the relevant deadline.

The recommended order for courses for a bachelor degree is presented in the figure. For many biochemistry courses there are some previous courses required as a prerequisite.

As a part of the studies in biochemistry, a student will use literature and/or results from course experiments to make many kinds of written exercises (reports, Pro gradu etc.) and presentations. A report cannot be a copy of the other text and all citations from other texts or figures must be clearly presented as references. Copying, using of the text of other students and other forms of plagiarism are forbidden and will lead to punishment and rejection of the report

<b>Yr3 autumn</b>	<b>Yr3 spring</b>
<p><b>BIOCHEMISTRY</b></p> <p>Cellular communication Introduction to immunology * Essay (B.Sc. thesis)</p> <p><b>EXTENSION SCHOOL</b></p> <p>Swedish, written skills Swedish, oral skills</p> <p><b>BIOLOGY</b></p> <p>Animal physiology, exercises *</p> <p><b>CHEMISTRY</b></p> <p>Laboratory course in organic chemistry I *</p> <p><b>SCIENCE AND TECHNOLOGY LIBRARY TELLUS</b></p> <p>Introduction to information retrieval*</p>	<p><b>BIOCHEMISTRY</b></p> <p>Physiological biochemistry * Radiation and safety * Maturity test Final examination Virology*</p> <p><b>BIOLOGY</b></p> <p>Developmental biology-histology*</p> <p><b>LABORATORY ANIMAL CENTRE</b></p> <p>Using animals in research - carrying out procedures *</p>
<b>Yr2 autumn</b>	<b>Yr2 spring</b>
<p><b>BIOCHEMISTRY</b></p> <p>Molecular biology I Metabolism II</p> <p><b>CHEMISTRY</b></p> <p>Organic chemistry I * Introduction to analytical chemistry *</p>	<p><b>BIOCHEMISTRY</b></p> <p>Physical biochemistry Cellular biology</p> <p><b>BIOLOGY</b></p> <p>Concepts of genetics for biochemists Animal physiology, lectures *</p> <p><b>MATHEMATICAL SCIENCES</b></p> <p>Introduction to statistics A second course in statistic</p>
<b>Yr1 autumn</b>	<b>Yr1 spring</b>
<p><b>BIOCHEMISTRY</b></p> <p>Orientation</p> <p><b>BIOLOGY</b></p> <p>Cell biology</p> <p><b>CHEMISTRY</b></p> <p>General and inorganic chemistry A General and inorganic chemistry B Introductory laboratory course in chemistry</p>	<p><b>BIOCHEMISTRY</b></p> <p>Metabolism I</p> <p><b>BIOLOGY</b></p> <p>Microbiology Transferable skills for biochemists</p> <p><b>EXTENSION SCHOOL</b></p> <p>English for biochemists I</p> <p>Introduction to organic chemistry</p>

### Recommended timing for B.Sc. courses in Biochemistry

\* Recommended optional studies

## Biochemistry as a minor subject

Biochemistry courses can be attended freely by students from other departments with only one restriction: We reserve right to not allow students on the course if the work places available in the laboratory or equipment available are insufficient. Also for laboratory exercises the student must have sufficient prior practical experience.

All courses and exams organized by faculty must be subscribed to via WebOodi (<https://weboodi oulu.fi/oodi>) before the relevant deadline.

A record of biochemistry as a minor subject will be given when the amount of accepted studies is at least 15 credits.

## Examinations and grades

The time and place of examinations are informed via timetables in the home page of faculty. Students must subscribe to exams via WebOodi (<https://weboodi oulu.fi/oodi>) before the relevant deadline. The grading scale is 0-5. The lowest passing grade is 1. Some courses are graded pass/fail. Three final exams are organized for each course. A course must be passed during the given time, not in another study year.

The final grade for Bachelor and Master degree in biochemistry and for biochemistry as a minor subject will be calculated as follows: the Grades of graded courses are multiplied by the number of credits. The final grade is the sum of products divided by the total number of credits.

Final grades will be determined as follows:

1/5	Sufficient	1,00 – 1,49
2/5	Satisfactory	1,50 – 2,49
3/5	Good	2,50 – 3,49
4/5	Very Good	3,50 – 4,49
5/5	Excellent	4,50 – 5,00

The final grade will be given by secretary of student affairs.

## Lines and degrees

Faculty of biochemistry and molecular medicine offers one bachelors level degree, **Biochemistry** and two masters level degrees, **Protein Science and Biotechnology** and **Molecular medicine**.

- 1) **Biochemistry**. B.Sc. Degree In Finnish and in English
- 2) **Protein Science and Biotechnology**. M.Sc. Degree entirely in English.
- 3) **Molecular medicine**. M.Sc. Degree In Finnish and in English.

In addition, the faculty of biochemistry and molecular medicine offers a Master's Degree Programme in Protein Science and Biotechnology for international students, whose curriculum differs slightly from the Protein Science and Biotechnology MSc.

## Bachelor of Science (Biochemistry)

Education leading to a Bachelor's degree in biochemistry provides the student with:

- apply fundamental knowledge in biochemistry and ancillary subjects and follow and evaluate developments in that field;
- apply scientific thinking and to use scientific methods;
- relate to and discuss the high public awareness and impact on society of biochemistry;
- complete responsible and goal-oriented teamwork and in individual work;
- capability to apply the acquired knowledge in working life;
- communicate in Finnish and Swedish as stipulated in the Degree Statute, as well as proficiency in English;
- demonstrate transferable and cognitive skills, including the ability to communicate effectively.

The credit requirement for the lower university degree of Bachelor of Science (Biochemistry) is 180. Studies are organized such that students can complete the degree within three years of full-time study. There is an option for a BSc Degree in biochemistry with international exchange. This includes additional appropriate compulsory language studies to allow integration of the student into the host environment during student exchange period. Student is free to select either of the BSc Degrees and may freely switch between degrees.

Obligatory course units at the beginning of studies are common to all students, but students also select course units specific to their longer-term goals.

A Bachelor's degree consists of the following elements:

B.Sc. Degree in biochemistry	
General studies	8 credits
Basic studies in Biochemistry	30 credits
Intermediate studies in Biochemistry	56 credits
Maturity test	0 credits
Chemistry	20 credits
Biology and statistic	18 credits

Optional studies*	48 credits
<b>Total at least</b>	<b>180 credits</b>

\* BSc studies must include a minor subject that comprises at least 25op of basic / intermediate studies

A Bachelor's degree with international exchange consists of the following elements:

<b>B.Sc. Degree in Biochemistry with international exchange</b>	
General studies	8 credits
Basic studies in Biochemistry	30 credits
Intermediate studies in Biochemistry	56 credits
Maturity test	0 credits
Chemistry	20 credits
Biology and statistic	18 credits
Appropriate language studies	up to 10 credits
Biochemical studies in the host university	12-30 credits
Other optional studies*	8-36 credits
<b>Total at least</b>	<b>180 credits</b>

\* BSc studies must include a minor subject that comprises at least 25op of basic / intermediate studies

## Master of Science (Protein Science and Biotechnology; Molecular medicine)

Education leading to a Master's degree in Protein Science and Biotechnology or Molecular medicine provides the student with:

- apply scientific knowledge and methods to topical tasks and to undertake scientific research with supervision;
- analyze information and data and their setting within a theoretical network accompanied by critical analysis and assessment;
- integrate the subject area as a coherent whole;
- communicate with good language skills for national and international tasks;
- demonstrate transferable and cognitive skills, including the ability to communicate effectively and critically about science using a variety of approaches;
- apply further knowledge, including the abilities to conceive, design and implement independent research and
- demonstrate capability for scientific postgraduate work.

A Master degree consists of the following elements:

<b>M.Sc. Degree</b>	
Obligatory advanced courses	71-79 credits
Maturity test	0 credits
Optional studies	41-49 credits
<b>Total at least</b>	<b>120 credits</b>

## STUDIES FOR B.Sc. DEGREE

<b>General studies 8 credits</b>	<b>credits</b>	<b>Semester</b>	<b>Unit</b>
Orientation (740076Y)	2	Autumn yr 1- Spring yr1	<i>FBMM</i>
English for biochemists I (902100Y)	3	Autumn yr 1-Spring yr 1	<i>Extension school</i>
Second official language (Swedish), written skills (901050Y)	1	Autumn yr 3	<i>Extension school</i>
Second official language (Swedish), oral skills (901051Y)	2	Autumn yr 3	<i>Extension school</i>
<b>Basic studies in biochemistry 30 credits</b>			<b><i>FBMM</i></b>
Biomolecules for biochemists (740143P)	8	Autumn yr 1-Spring yr 1	
Biochemical methodologies I (740144P)	8	Autumn yr 1-Spring yr 1	
Metabolism I (740146P)	6	Spring yr 1	
Physical biochemistry (740145P)	6	Spring yr 2	
Transferable skills for biochemists (740150P)	2	Spring yr 1	
<b>Intermediate studies in biochemistry 56 credits</b>			<b><i>FBMM</i></b>
Molecular biology I (740361A)	8	Autumn yr 2	
Microbiology (740363A)	6	Spring yr 1	
Protein chemistry I (740364A)	8	Autumn yr 2	
Cellular biology (740362A)	6	Spring yr 2	

Metabolism II (740367A)	6	Autumn yr 2	
Essay (B.Sc. thesis) (740376A)	10	Autumn yr 3	
Cellular communication (740366A)	6	Autumn yr 3	
Maturity test (740377A)	0	Spring yr 3	
Final examination (740372A)	6	Spring yr 3	
<b>Chemistry 20 credits</b>			<b>Chemistry</b>
General and inorganic chemistry A (780117P)	5	Autumn yr 1	
General and inorganic chemistry B (780118P)	5	Autumn yr 1	
Introductory laboratory course in chemistry (780123P)	5	Autumn yr 1	
Introduction to organic chemistry (780116P)	5	Autumn yr 1-Spring yr 1	
<b>Biology and statistics 18 op</b>			
Cell biology (750121P)	5	Autumn yr 1	<i>Biology</i>
Concepts of genetics for biochemists (753122P)	3	Spring yr 2	<i>Biology</i>
Introduction to statistics (806118P)	5	Spring yr 2	<i>Mathematics</i>
A second course in statistics (806119P)	5	Spring yr 2	<i>Mathematics</i>
<b>Recommended optional studies</b>			
Radiation and safety (740368A)	5	Spring yr 3	<i>FBMM</i>
Introduction to immunology (740379A)	3	Autumn yr 3	<i>FBMM</i>
Virology (740380A)	3	Spring yr 3	<i>FBMM</i>
Physiological biochemistry (740371A) *	4	Spring yr 3	<i>FBMM</i>
Animal physiology, lectures (751323A) *	5	Spring yr 2	<i>Biology</i>
Animal physiology, exercises (755318A)	4	Autumn yr 3	<i>Biology</i>
Developmental biology-histology (751320A)	5	Spring yr 3	<i>Biology</i>
Introduction to analytical chemistry (780119P)	5	Autumn yr 2	<i>Chemistry</i>
Laboratory course in organic chemistry I (780307A)	5	Autumn yr 3	<i>Chemistry</i>
Organic chemistry I (780305A)	5	Autumn yr 2	<i>Chemistry</i>
Using animals in research - carrying out procedures (040911S) probably this course is not organized every 3 year in English		Spring yr 3	<i>Laboratory Animal Centre</i>
Introduction to information retrieval (030005P)	1	Year 3	<i>Tellus</i>
Tutoring / confidential posts (740074Y)	1,5	Year 2-3	<i>FBMM</i>

\* at least one of these is required

<b>Other optional studies</b>			
Orientation to research work (740383A)/Orientation to biochemical work (740382A)	0-6	Year 1-3	<i>FBMM</i>
Biochemical and biomedical Innovation (740381A)	2-5	Year 1-3	<i>FBMM</i>

## Optional studies

BSc degree in biochemistry includes 48 credits of optional studies. Recommended optional courses are put together in the time table so that they do not clash with obligatory courses. However, students are free to select other university courses either in Finland or abroad. The content of courses must not be too similar to obligatory courses. Courses taken outside University of Oulu should be agreed with University lecturer Jari Heikkinen in advance. BSc studies must include a minor subject that comprises at least 25op of basic / intermediate studies. Students are advised to do the minor subject in either chemistry or biology (compulsory studies in these subjects can be included in the 25op total).

## STUDIES FOR B.Sc. DEGREE WITH INTERNATIONAL EXCHANGE

<b>General studies 8 credits</b>	<b>credits</b>	<b>Semester</b>	<b>Unit</b>
Orientation (740076Y)	2	Autumn yr 1- Spring yr1	<i>FBMM</i>
English for biochemists I (902100Y)	3	Autumn yr 1-Spring yr 1	<i>Extension school</i>
Second official language (Swedish), written skills (901050Y)	1	Autumn yr 3	<i>Extension school</i>

Second official language (Swedish), oral skills (901051Y)	2	Autumn yr 3	<i>Extension school</i>
<b>Basic studies in biochemistry 30 credits</b>			<b><i>FBMM</i></b>
Biomolecules for biochemists (740143P)	8	Autumn yr 1-Spring yr 1	
Biochemical methodologies I (740144P)	8	Autumn yr 1-Spring yr 1	
Metabolism I (740146P)	6	Spring yr 1	
Physical biochemistry (740145P)	6	Spring yr 2	
Transferable skills for biochemists (740150P)	2	Spring yr 1	
<b>Intermediate studies in biochemistry 56 credits</b>			<b><i>FBMM</i></b>
Molecular biology I (740361A)	8	Autumn yr 2	
Microbiology (740363A)	6	Spring yr 1	
Protein chemistry I (740364A)	8	Autumn yr 2	
Cellular biology (740362A)	6	Spring yr 2	
Metabolism II (740367A)	6	Autumn yr 2	
Essay (B.Sc. thesis) (740376A)	10	Autumn yr 3	
Cellular communication (740366A)	6	Autumn yr 3	
Maturity test (740377A)	0	Autumn yr 3	
Final examination (740372A)	6	Spring yr 3	
<b>Chemistry 20 credits</b>			<b><i>Chemistry</i></b>
General and inorganic chemistry I (780117P)	5	Autumn yr 1	
General and inorganic chemistry II (780118P)	5	Autumn yr 1	
Introductory laboratory course in chemistry (780123P)	5	Autumn yr 1	
Introduction to organic chemistry (780116P)	5	Autumn yr 1-Spring yr 1	
<b>Biology and statistics 18 credits</b>			
Cell biology (750121P)	5	Autumn yr 1	<i>Biology</i>
Concepts of genetics for biochemists (753122P)	3	Spring yr 2	<i>Biology</i>
Introduction to statistics (806118P)	5	Spring yr 2	<i>Mathematics</i>
A second course in statistics (806119P)	5	Spring yr 2	<i>Mathematics</i>
<b>Appropriate language studies up to 10 credits</b>		autumn yr2-spring yr3	<i>Extension school</i>
<b>Biochemical studies in the host university 12-30 credits</b>		Spring yr3	<i>Host university</i>
<b>Recommended optional studies</b>			
Introduction to immunology (740379A)	3	Autumn yr 3	<i>FBMM</i>
Animal physiology, lectures (751323A) *	5	Spring yr 2	<i>Biology</i>
Animal physiology, exercises (755318A)	4	Autumn yr 3	<i>Biology</i>
Introduction to analytical chemistry (780119P)	5	Autumn yr 2	<i>Chemistry</i>
Laboratory course in organic chemistry I (780307A)	5	Autumn yr 3	<i>Chemistry</i>
Organic chemistry I (780305A)	5	Autumn yr 2	<i>Chemistry</i>
Introduction to information retrieval (030005P)	1	Year 3	<i>Tellus</i>
Tutoring / confidential posts (740074Y)	1,5	Year 2-3	<i>FBMM</i>
* One course in physiology is required. An alternative to animal physiology is physiological biochemistry but this is normally taken Spring yr3.			
<b>Other optional studies</b>			
Orientation to research work (740383A)/Orientation to biochemical work (740382A)	0-6	Year 1-3	<i>FBMM</i>
Biochemical and biomedical Innovation (740381A)	2-5	Year 1-3	<i>FBMM</i>

## Appropriate language studies

Appropriate compulsory language studies (8-10 credits) should be taken prior the exchange period. The courses can be selected from repertoire of Language and Communication and/or Open university. Autumn yr2-autumn yr3 is the ideal period for these studies. The language courses given by the host university at the beginning of exchange period will be accepted too.

## Optional studies

BSc degree in biochemistry with international exchange includes 38 - 48 credits of optional studies. A minimum of 12 credits of these must be passed in host university during exchange period (biochemistry courses). Recommended optional courses at University of Oulu are put together in the time table so that they do not clash with obligatory courses. However, students are free to select other university courses either in Finland or abroad. The content of courses must not be too similar to obligatory courses. Courses taken outside University of Oulu should be agreed with University lecturer Jari Heikkinen in advance. BSc studies must include a minor subject that comprises at least 25op of basic / intermediate studies. Students are advised to do the minor subject in either chemistry or biology (compulsory studies in these subjects can be included in the 25op total).

### Courses for minor subject students

	credits	semester
Biomolecules (740148P)	5	Autumn-Spring
Biomolecules for Bioscientists (740147P)	8	Autumn-Spring
Metabolism I (740149P)	4	Spring
Microbiology (740374A)	3	Spring
Molecular biology I (740373A)	4	Autumn

## STUDIES FOR M.Sc.DEGREE

In addition to compulsory and optional specialist courses (minimum 3 courses) student must select other courses listed in any MSc line (for minimum 120 credits), all together at least 105 credits. The remaining 15 credits can be either any other MSc courses or any other suitable courses according to student's career aspirations. Student is free to take courses from both lines and decide later according to subject of Pro Gradu work which MSc line to graduate in.

### Protein Science and Biotechnology (120 credits)

Compulsory courses	credits	Semester
Protein chemistry II (744620S)	3	Autumn yr1
Molecular biology II (744621S)	3	Autumn yr1
Biochemical methodologies II (747608S)	8	Autumn yr1
Scientific communication for biochemists (902154Y)	5	Spring yr1
Orientation to research work (744617S) / Orientation to biochemical work (744624S)	12-20	Autumn yr 1-Spring yr 1
Pro gradu experimental work in protein science and biotechnology (747691S)	28	
Pro gradu thesis in protein science and biotechnology (747692S)	20	
Maturity test (M.Sc. degree) (740672S)	0	
Optional specialist courses (a minimum of 3 of these courses must be taken)		
In silico methodologies in biochemistry and molecular medicine (747613S)	5	Autumn
Systems biology (744619S)	4	Autumn
Structural enzymology (747606S)	3	Autumn
Biochemistry of protein folding (747611S)	3	Spring
Macromolecular X-ray crystallography (747614S)	5	Spring
Introduction to structure-based drug discovery (747615S)	5	Spring
Other optional courses		
Dissertation (744618S)	18	
Scientific presentation (744625S)	1-2	
Final examination in protein science and biotechnology (747693S)	9	
Yeast genetics (744623S)	3-6	Spring
Biochemical and biomedical Innovation (740381A)	2-5	yr1-yr2
Advanced information skills (300002M, Science and Technology library Tellus)	1	
Bioreactor technology (488321S, Bioprocess Engineering)	5	Autumn
Advanced course for biotechnology (488305S, Bioprocess Engineering)	5	Spring
Using animals in research - carrying out procedures (040911S, Laboratory Animal Centre)*	3	spring
Optional courses at any university	0-15	
Any other MSc level course offered by the Faculty of biochemistry and molecular medicine		

\*probably this course is not organized every year in English



**Molecular medicine (120 credits)**

<b>Obligatory courses</b>	<b>credits</b>	<b>Semester</b>
Protein chemistry II (744620S)	3	Autumn yr 1
Molecular biology II (744621S)	3	Autumn yr 1
Scientific communication for biochemists (902154Y)	5	Spring yr1
Orientation to research work (744617S) / Orientation to biochemical work (744624S)	12-20	Autumn yr 1-Spring yr 1
Pro gradu experimental work in molecular medicine (743697S)	28	
Pro gradu thesis in molecular medicine (743698S)	20	
Maturity test (740672S)	0	
<b>Optional specialist courses (a minimum of 3 of these courses must be taken)</b>		
Hypoxia response pathway – molecular mechanisms and medical applications (743664S)	5	autumn
Systems biology (744619S)	4	autumn
Molecular, cell biological and genetic aspects of diseases (743665S)	5	autumn
Extracellular matrix (743662S)	5	spring
Developmental biology, stem cells and tissue engineering (743663S)	5	spring
Tumor cell biology (743657S)	3	spring
<b>Other optional courses</b>		
In silico methodologies in biochemistry and molecular medicine (747613S)	5	Autumn
Biochemical methodologies II (747608S)	8	Autumn yr1
Dissertation (744618S)	18	
Virology (743661S)	3	spring
Scientific presentation (744625S)	1-2	
Introduction to immunology (743660S)	3	Autumn-Spring
Final examination in molecular medicine (743699S)	9	
Yeast genetics (744623S)	3-6	Spring
Structural enzymology (747606S)	3	Spring
Biochemistry of protein folding (747611S)	3	Spring
Biochemical and biomedical Innovation (740381A)	2-5	yr1-yr2
Introduction to structure-based drug discovery (747615S)	5	Spring
Advanced information skills (300002M, Science and Technology library Tellus)	1	
Plant hormones (756627S)(Dept. of Biology)	4	Spring
Biomedical imaging methods (580402S) (Institute of biomedicine)	4	
Using animals in research - carrying out procedures (040911S, Laboratory Animal Centre)	3	spring
Optional courses at any university	0-15	
Any other MSc level course offered by the Faculty of biochemistry and molecular medicine		

**International Master's Degree Programme in Protein Science and Biotechnology (120 credits)**

<b>Obligatory courses</b>	<b>credits</b>	<b>Semester</b>
Protein production and analysis (747601S)	8	Autumn yr1
Biochemical methodologies II (747608S)	8	Autumn yr1
Orientation to research work (744617S) / Orientation to biochemical work (744624S)	12-18	Spring yr 1
Pro gradu experimental work in protein science and biotechnology (747691S)	28	
Pro gradu thesis in protein science and biotechnology (747692S)	20	
Maturity test (M.Sc. degree) (740672S)	0	
<b>Optional specialist courses (at least 3 must be taken)</b>		
In silico methodologies in biochemistry and molecular medicine (747613S)	5	Autumn
Systems biology (744619S)	4	Autumn
Structural enzymology (747606S)	3	Autumn
Biochemistry of protein folding (747611S)	3	Spring
Macromolecular X-ray crystallography (747614S)	5	Spring

Introduction to structure-based drug discovery (747615S)	5	Spring
<b>Optional courses</b>		
Dissertation (744618S)	18	
Scientific presentation (744625S)	1-2	
Final examination in protein science and biotechnology (747693S)	9	
Scientific communication for biochemists (902154Y)	5	Spring
Yeast genetics (744623S)	3-6	Spring
Information Skills for foreign degree students (030008P) Science and Technology library Tellus)	1	
Bioreactor technology (488321S, Bioprocess Engineering)	5	Autumn
Advanced course for biotechnology (488305S, Bioprocess Engineering)	5	Spring
Using animals in research - carrying out procedures (040911S, Laboratory Animal Centre )*	3	spring
Any other MSc level course offered by the Faculty of biochemistry and molecular medicine		

\*probably this course is not organized every year in English

### Optional courses at any universities

Up to 15 credits of courses can be taken from other suitable courses taught at any university (for minimum 120 credits of MSc Degree). Also courses given by research units eg. Biocenter Oulu will be accepted. Courses must be connected to biochemistry or logically support some aspect of it and they will have to be at an appropriate level. The content of the courses must not be too similar to other courses which have counted towards the students BSc degree or towards their MSc. In all cases Amanuensis Jari Heikkinen should be contacted to confirm acceptance / suitability. We would advise that this is done before the course is taken, especially in the case of courses taken from universities outside Finland. A list of previously accepted courses can be found on the teaching pages of the faculty web pages, please consult this list before contacting Amanuensis Jari Heikkinen.

### Faculty Staff

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# Course descriptions

## B.Sc. Degree

### General and basic studies (biochemistry)

#### 740074Y Pienryhmäohjaus/Luottamustoimet (1.5cp)

Tutoring/confidential posts

**ECTS Credits:** 1.5 credits

**Contents:** For this study a student acts as a tutor for a group of new students, as a member of Working group on development of teaching (OKTR) or as a member of working committee of OKTR.

**Learning activities and teaching methods:** 10-20 h tutoring of a small group, autumn yr2-yr3, activity in Working group on development of teaching (OKTR) or in working committee of OKTR. Optional.

**Assessment methods and criteria:** Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:** pass/fail

**Person responsible:** Amanuensis

**Other information:** Location of instruction: Linnanmaa, Kontinkangas

#### 740076Y Orientoivat opinnot (2cp)

Orientation

- **Learning outcomes:** Upon completion of the course the students should be able to: go in Linnanmaa and Kontinkangas campus and find various supporting services
- use university terminology
- plan his studies and create a personal study plan (PSP) according to BSc degree structure
- use Weboodi to support his studies
- describe research work done in the faculty and biochemist's work

**Contents:** Course familiarizes students with university studies and environment and illustrate goals and content of biochemistry degree programme. Under the guidance of faculty personnel (Chaperones) students see the spectrum of scientific research done in the Faculty and biochemists doing a research work. In a seminar "biochemist in working life" biochemists graduated from the Faculty give a talk on their experiences in working life.

**Mode of delivery:** Face to face teaching

**Learning activities and teaching methods:** 10-15 h group work (small group tutoring), 16 h presentation of research work done in the Faculty, 2 h seminar

**Target group:** yr1 BSc students

**Prerequisites and co-requisites:** -

**Recommended optional programme components:** -

**Recommended or required reading:** -

**Assessment methods and criteria:** Active attendance

**Grading:** Pass/fail

**Person responsible:** Jari Heikkinen and small group tutors

and chaperones

**Working life cooperation:** No

**Other information:** Location of instruction: Linnanmaa and Kontinkangas

#### 740078Y Työelämäkurssi (6cp)

Working life course

**ECTS Credits:** 6 credits

**Language of instruction:** Finnish

**Timing:** B.Sc. yr1-3 spring

- **Learning outcomes:** Upon successful completion students are able to describe transferable working life skills, independent of the working environment
- recognize and describe their own skills
- assess themselves as an expert, as an applicant and as an employee
- recognize those working life skills which may need improvement
- compose their "skill profile"

**Contents:** Workshops will address the generic working life skills which are needed in every working environment. Communication, social interaction, group work, organizing, time management, giving and receiving feedback are among the topics studied. The skills and experiences the students have obtained already, will be recognized and considered in terms of how to best present them when applying for a job for instance. The summer job, which needs to last at least 1 month, can be of any branch. During the summer job, the students will have assignments concerning working life related issues, e.g. safety, working environment or interactions between people at the working place. By the end of the course the students will write a report to describe their experiences reflecting the development of their working life skills. Reports will be evaluated by the teacher and also by a fellow student. Thus also giving constructive feedback to a fellow student will be practiced.

**Mode of delivery:** Face to face teaching

**Learning activities and teaching methods:** Three workshops (3 x 3h) are organized before the summer job. A small part of the teaching in workshops is lecturing, mostly learning takes place via group work, discussions and assignments. No separate report of the workshops is required. The summer job (min. 1 month) is accompanied with assignments and a final report. Evaluation of a report from a fellow student is included.

**Target group:** B.Sc. students

**Prerequisites and co-requisites:** Summer job for at least 1 month. The field of work is not specified.

**Recommended optional programme components:** -

**Recommended or required reading:** Info on recommended reading will be given in workshops.

**Assessment methods and criteria:** Participation in the

workshops, summer job, assignments, report, evaluation.

**Grading:** Pass/Fail

**Person responsible:** Anne Mäkelä

**Working life cooperation:** Yes

**Other information:** Location of workshops (Kontinkangas/Linnanmaa campus) will be announced separately.

#### 740143P Biomolecules for Biochemists (8cp)

Biomolecules for Biochemists

**ECTS Credits:** 8 credits

**Language of instruction:** English

**Timing:** B.Sc yr1 autumn-spring

- **Learning outcomes:** Upon successful completion students are able to: tell the composition, structure and function of the major groups of biomolecules in cells; nucleic acids, proteins, carbohydrates and lipids and describe the forces that modulate their function.
- apply information in the right context and evaluate it critically
- In addition, students on the 8op versions are able to work in the biochemical laboratory, are able to solve calculations and problems and are able to interpret the scientific data they generate.

**Contents:** This module provides an overview of biochemistry, outlining the forces involved in biomolecule structure and the chemical structures and properties of polynucleic acids, proteins, carbohydrates and lipids. There will also be an introduction to prebiotic evolution and a student debate on this subject. The module is arranged into lectures, workshops, a student debate and laboratory work. All of the exercises are in English. Both a final examination and continuous assessment will count towards the final mark and attendance of some parts is compulsory.

**Mode of delivery:** Face to face teaching

**Learning activities and teaching methods:** 30 h lectures, 48 h lab., plus exercises

**Target group:** Major students

**Prerequisites and co-requisites:** -

**Recommended optional programme components:** -

**Recommended or required reading:** Mathews, van Holde & Ahern: Biochemistry, (3rd edition), published by Addison Wesley Longman, Inc. or equivalent.

**Assessment methods and criteria:** Continuous assessment, final examination Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:** 1-5/fail

**Person responsible:** Tuomo Glumoff

**Working life cooperation:** No

**Other information:** Location of instruction: lectures and computing at Linnanmaa campus, wet labs at Kontinkangas campus

#### 740144P Biokemian menetelmät I (8cp)

Biochemical Methodologies I

**ECTS Credits:** 8 credits

**Language of instruction:** Finnish

**Timing:** B.Sc. yr1 autumn (lectures), yr1 spring (laboratory practicals)

- **Learning outcomes:** Upon successful completion students are able to: use basic methods used in biochemical research laboratory
- Use laboratory equipment and work safely
- Prepare solutions used in the lab
- document experiments in the laboratory

**Contents:** This module covers the basic methodologies used in practical biochemistry. The following topics will be addressed: safety in the laboratory, qualitative and quantitative observations, the calculations of concentrations and dilution factors (includes a workshop), pipette cleaning and calibration, identification and quantification of biological

molecules, principles and practice of the use of centrifuges, spectrophotometry, SDS-PAGE, agarose gel electrophoresis, thin-layer and paper chromatography, basics of protein purification, extraction of chromosomal DNA from bacteria, mini-prep extraction of plasmid DNA, extraction of RNA from mammalian tissue, extraction of lipids from nutmeg, sterile technique, basic microbial growth, dialysis, filtration and pH measurement.

**Mode of delivery:** Face to face teaching

**Learning activities and teaching methods:** 18 h lecture, 2h exercises, 120 h lab. Laboratory work is compulsory. It is possible to complete lecture part only (3.5 ECTS).

**Target group:** Major students, Biology BSC-BS

**Prerequisites and co-requisites:** Biomolecules, Biomolecules for Biochemists tai Biomolecules for Bioscientists

**Recommended optional programme components:** -

**Recommended or required reading:** Recommended reading: Reed, Holmes, Weyers & Jones: Practical skills in biomolecular sciences, 4th edition, Pearson, 2013. You can check the availability of the course books via [this link](#)

**Assessment methods and criteria:** Continuous assessment (home works, lab reports), final exam Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:** 1-5/fail

**Person responsible:** Jari Heikkinen

**Working life cooperation:** No

**Other information:** Location of instruction: lectures (in Finnish) at Linnanmaa campus, laboratory practicals at Kontinkangas campus.

#### 740145P Physical Biochemistry (6cp)

Physical Biochemistry

**ECTS Credits:** 6 credits

**Language of instruction:** English

**Timing:** B.Sc. yr2 spring

- **Learning outcomes:** Upon successful completion students are able to: define the relevance of theoretical concepts to the biosciences
- tell where various equations of physical biochemistry come from
- discuss the link between theory and experiment
- perform simple but realistic calculations

**Contents:** This module will cover the concepts of thermodynamics and their application to biochemical systems plus chemical and enzymatic kinetics. Topics covered will include:

Concepts of thermodynamics: First, Second and Third Law of Thermodynamics. Heat. Work. Enthalpy. Entropy, Gibbs and Helmholtz free energy, Chemical potential, Chemical potential of a solute, Free energy and equilibrium.

Applications of thermodynamics: Chemical reactions, Protein-ligand association, Acids, bases and pH regulation, Acid-dissociation constants, introduction to thermodynamics of protein folding.

Chemical kinetics: Basic chemical reactions and single step reactions, Applications of chemical kinetics to multistep reactions, Catalysis and enzyme kinetics.

Attendance of some parts of the course is compulsory.

**Mode of delivery:** Face to face teaching

**Learning activities and teaching methods:** 36 h lecture and exercises

**Target group:** Major students

**Prerequisites and co-requisites:** -

**Recommended optional programme components:** -

**Recommended or required reading:** Recommended books:

Price NC et al., Principles and problems in Physical chemistry for Biochemists, Third edition, Oxford University Press, Oxford, 2001.

Atkins P and De Paula J, Physical chemistry, 8ed, Oxford

University Press, Oxford, 2006.

Atkins P and de Paula J. Physical chemistry for the life science, Oxford University Press, Oxford, 2006.

**Assessment methods and criteria:** Homeworks, workshops, no exam Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:** 1-5/fail

**Person responsible:** André Juffer

**Working life cooperation:** No

**Other information:** Location of instruction: Kontinkangas campus

#### 740146P Aineenvaihdunta I (6cp)

Metabolism I

**ECTS Credits:** 6 credits

**Language of instruction:** Finnish

**Timing:** B.Sc. yr1 spring

**Learning outcomes:** Students will be able to explain the main principles of how the metabolism is made up, will get a detailed picture of the energy metabolism, and will be able to organize part of the wholeness of metabolism, particularly how energy metabolism is networked to the synthesis and degradation of biomolecules.

**Contents:** On this course the central concepts and mechanisms of metabolism, its regulation and the integration of metabolic pathways will be introduced, like anabolism and catabolism, linking of different pathways, and metabolic regulation. Especially the energy metabolism will be studied, concerning carbohydrates, lipids and the respiratory chain. Combined with the course Metabolism II the students will get a good overview on the principles of metabolism, metabolic integration and the methods to study metabolism.

**Mode of delivery:** Face to face teaching

**Learning activities and teaching methods:** Lectures (28 h), problem-based exercises (workshops) 6 h, laboratory work (32 h, attendance obligatory), lab diary and final exam.

**Target group:** Major subject students

**Prerequisites and co-requisites:** Biomolecules, Biomolecules for Biochemists or Biomolecules for Bioscientists

**Recommended optional programme components:** Biomolecules, Biomolecules for Biochemists tai Biomolecules for Bioscientists

**Recommended or required reading:** -

**Assessment methods and criteria:** Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:** 1-5/fail. Problem-based exercises, laboratory work and a final exam will count towards the final grade.

**Person responsible:** Tuomo Glumoff

**Working life cooperation:** No

**Other information:** Location of instruction: Lectures: Linnanmaa, laboratory: Kontinkangas

#### 740150P Valmiustaitoja biokemisteille (2cp)

Transferable skills for biochemists

**ECTS Credits:** 2 credits

**Language of instruction:** Finnish

**Timing:** BSc yr1 spring

- **Learning outcomes:** Upon successful completion students are able to: process gel photographs taken in practicals and embed them into lab reports
- use Microsoft Word to write reports
- create standard curves using Microsoft Excel
- explain how to construct a good oral presentation
- list the basics of good scientific practice

**Contents:** An overview is given of a commonly used word processor (Microsoft Word) and spreadsheet (Microsoft Excel). Students will be taught to use these software to create lab reports (word processing, gel photograph

processing and embedding in lab reports). Other topics are the basics of oral presentation, ethics in scientific research and good scientific practice. Attendance of some parts is compulsory.

**Mode of delivery:** Face to face teaching

**Learning activities and teaching methods:** Lectures and computer practicals all together 14 hr, home exercises

**Target group:** Major students

**Prerequisites and co-requisites:** -

**Recommended optional programme components:** -

**Recommended or required reading:** Recommended reading: Reed, Holmes, Weyers & Jones: Practical skills in biomolecular sciences, 4th edition, Pearson, 2013. You can check the availability of the course books via [this link](#)

**Assessment methods and criteria:** Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:** pass/fail

**Person responsible:** Tuomo Glumoff

**Working life cooperation:** No

**Other information:** Location of instruction: Linnanmaa, partly Kontinkangas

#### 740361A Molekyylibiologia I (8cp)

Molecular Biology I

**ECTS Credits:** 8 credits

**Language of instruction:** Finnish

**Timing:** B.Sc. yr2 autumn

**Learning outcomes:** After this course students should understand the basics of molecular biology and be able to use modern molecular biology methods.

**Contents:** The course covers gene structure, DNA replication, recombination, transcription, translation and basics of gene expression. The student will learn the most common recombinant DNA techniques, such as PCR, use of restriction endonucleases, preparation of recombinant plasmids and DNA sequencing. Attendance of some parts is compulsory.

**Mode of delivery:** Face to face teaching

**Learning activities and teaching methods:** 20 h lectures, 4 h computer exercise, 80 h lab, theoretical exercises, homeworks

**Target group:** Major subject students

**Prerequisites and co-requisites:** Cellular biology, Biomolecules for Biochemists and Biochemical methodologies I

**Recommended optional programme components:** -

**Recommended or required reading:** Mathews, CK, van Holde KT, Applins DR, Anthony-Cahill SJ: Biochemistry (4th edition). Optional.

**Assessment methods and criteria:** Homeworks 40 %, lab reports 20 % and final exam 40 %. Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:** 1-5/fail.

**Person responsible:** Mirva Saaranen and Aki Manninen

**Working life cooperation:** No

**Other information:** Location of instruction: Lectures: Linnanmaa, laboratory: Kontinkangas

#### 740362A Solun biologia (6cp)

Cellular Biology

**ECTS Credits:** 6 credits

**Language of instruction:** Finnish

**Timing:** B.Sc. yr2 spring

- **Learning outcomes:** Upon successful completion students are able to: interpret and analyze the general molecular mechanisms of cell functions
- plan how such molecular mechanisms can be studied in vitro and in vivo
- track the molecular defects that might be responsible for abnormal functioning of cells e.g. in disease states



**Contents:** The aim of the course is to deepen the knowledge about where in the cell different biochemical reactions take place, how the molecules are trafficked between organelles, and how these phenomena can be studied in cultured cells. The course aims to address specifically the specific functions of the organelles in an eukaryotic cell, transport of material into and out of the cells, and how the cytoskeleton serves many of these functions. The course contains practical lab work, during which the students learn basic skills on cell culture and fluorescence microscopy. The practical course is compulsory for the Biochemistry students.

**Mode of delivery:** Face to face teaching

**Learning activities and teaching methods:** 24 h lectures, 40 h lab

**Target group:** Major students

**Prerequisites and co-requisites:** Cell biology, Biomolecules for biochemists, Biochemical methodologies I

**Recommended optional programme components:** -

**Recommended or required reading:** Lodish, et al., Molecular Cell Biology (partly), 4th edition. W.H. Freeman and Company

**Assessment methods and criteria:** Lab reports, final exam  
Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:** 1-5/fail

**Person responsible:** Sakari Kellokumpu

**Working life cooperation:** No

**Other information:** Location of instruction: Kontinkangas

#### 740363A Mikrobiologia (6cp)

Microbiology

**ECTS Credits:** 6 credits

**Language of instruction:** English

**Timing:** B.Sc. yr1 spring

- **Learning outcomes:** Upon successful completion students are able to: define the typical features of bacteria, archaea, fungi and virus and explain the diversity of different groups of microorganisms
- explain the basic aspects of microbial metabolism
- understand the basics of microbial growth, enrichment, culture and growth control both in the environment and in contained culture
- explain the essential roles of microorganisms in our environment
- apply their knowledge for the growth and its control of standard laboratory microorganisms
- have a basic understanding of the industrial use of microorganisms or microbial compounds.

**Contents:** This module is an introduction to general and applied microbiology and consists of lecture and laboratory exercises. In the lectures, the diversity and classification of microorganisms, especially bacteria will be introduced. Further topics are the structure and function of the prokaryotic cell, bacterial growth, metabolism and physiology, the importance of bacteria in different ecosystems as well as the industrial use of bacteria. The exercises introduce basic microbiological methods and techniques for the aseptic work. These include culture on solid and in liquid media, transfer of bacteria by streaking or spreading, the use of dilution and enrichment techniques, the inhibition of bacterial growth, measurement of bacterial growth and death, and finally the basics of transformation and bacteriophage infection and its use in molecular biology. Attendance at practical course is obligatory.

**Mode of delivery:** Face to face teaching

**Learning activities and teaching methods:** 24 hours lecture and 60 hours laboratory exercises

**Target group:** Major students

**Prerequisites and co-requisites:** Biomolecules for Biochemists and Biochemical methodologies I

**Recommended optional programme components:** -

**Recommended or required reading:** M. Salkinoja-Salonen (ed.) (2002) Mikrobiologian perusteita, Helsingin yliopisto; Michael T. Madigan, John M. Martinko, Paul V. Dunlap, and David P. Clark Parker (2010) Brock biology of microorganisms, 12th ed. Prentice Hall International. Microbiology laboratory exercises, Dept. Biochemistry (2010).

**Assessment methods and criteria:** Continuous assessment (home works, lab reports), final exam  
Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:** 1-5/fail

**Person responsible:** Helmut Pospiech

**Working life cooperation:** No

**Other information:** Location of instruction: Lectures: Linnanmaa, laboratory: Kontinkangas

#### 740364A Protein Chemistry I (8cp)

Protein Chemistry I

**ECTS Credits:** 8 credits

**Language of instruction:** English

**Timing:** B.Sc. yr2 autumn

- **Learning outcomes:** Upon successful completion students are able to: tell the relevance of protein structure, including post-translational modification, to protein function
- describe the techniques available to purify proteins and to study protein function and have an appreciation of the applications and limitations of these techniques
- analyze a wide range of biochemical data and solve problems relating to the interpretation of data concerning protein function and basic structural characterization

**Contents:** This module provides more detailed information on the chemistry of proteins. Topics covered include protein purification, reversible and irreversible covalent modifications of proteins, protein translocation, protein degradation, an introduction to the protein folding problem, protein structure analysis, basic enzyme catalysis mechanisms and co-enzymes. The module includes lectures, continuous assessments, group works, student presentations, and laboratory exercises. Final examination, lecture attendance/ continuous assessments, presentations and laboratory reports will all count towards the final mark. Attendance at laboratory exercises is obligatory.

**Mode of delivery:** Face to face teaching

**Learning activities and teaching methods:** 30 h lectures, 80 h lab, exercises

**Target group:** Major students

**Prerequisites and co-requisites:** Biomolecules for Biochemists, Biochemical methodologies I

**Recommended optional programme components:** -

**Recommended or required reading:** Recommended reading: Greighton: Proteins, Structure and Molecular Properties, W.H. Freeman & Co, 2002 (2nd ed.)

**Assessment methods and criteria:** Presentation, lab reports, final exam, attendance / continuous assessment  
Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:** 1-5/fail

**Person responsible:** Kristian Koski

**Working life cooperation:** No

**Other information:** Location of instruction: Lectures at Linnanmaa campus, laboratory exercises at Kontinkangas campus.

#### 740366A Cellular Communication (6cp)

Cellular Communication

**ECTS Credits:** 6 credits

**Language of instruction:** English

**Timing:** B.Sc. yr3 autumn

- **Learning outcomes:** 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:** 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.

**Mode of delivery:** Face to face teaching

**Learning activities and teaching methods:** 20 h lectures, 32 h practicals

**Target group:** Major students

**Prerequisites and co-requisites:** Cellular biology

**Recommended optional programme components:** -

**Recommended or required reading:** -

**Assessment methods and criteria:** Laboratory practicals, final exam Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:** 1-5/fail

**Person responsible:** Thomas Kietzmann

**Working life cooperation:** No

**Other information:** Location of instruction: Kontinkangas campus

#### 740367A Aineenvaihdunta II (6cp)

Metabolism II

**ECTS Credits:** 6 credits

**Language of instruction:** Finnish

**Timing:** B.Sc. yr2 autumn

**Learning outcomes:** Students should be able to outline in detail how cells use various small and large molecules, how cells synthesize and degrade metabolites for their needs, and how metabolic network is connected and integrated.

**Contents:** Metabolism II completes the discussion of energy metabolism by combining it with metabolism of nitrogen-containing compounds and synthesis and degradation of different biomolecules, as well as extends the analysis of the central concepts and mechanisms of metabolism. It will be seen how the metabolic pathways that were examined separately will be connected to each other and regulated. Some chemical mechanisms of pathways as well as ways to supply precursors for the main stream pathways will be handled. Special aspects of metabolism, like tissue specificity and physiological states, will also be studied. Photosynthesis is studied as continuation to energy metabolism.

**Mode of delivery:** Face to face teaching

**Learning activities and teaching methods:** Lectures 29h, workshops 27h, 4 workshop reports, final exam. Attendance at workshops is obligatory.

**Target group:** Major subject students

**Prerequisites and co-requisites:** Metabolism I

**Recommended optional programme components:** -

**Recommended or required reading:** -

**Assessment methods and criteria:** Continuous assessment (homeworks, workshops), final exam Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:** 1-5/fail

**Person responsible:** Lauri Eklund

**Working life cooperation:** No

**Other information:** Location of instruction: Linnanmaa

#### 740368A Radiokemia ja säteilyturvallisuus (5cp)

Radiation and Safety

**ECTS Credits:** 5 credits

**Language of instruction:** Finnish

**Timing:** B.Sc. yr3 spring

- **Learning outcomes:** Upon completion the students should be able to explain the character of ionizing radiation
- tell examples of biological effects of radiations
- work safely in the isotope laboratory
- summarize legislation and regulatory guides on radiation safety

**Contents:** This course is composed of two lecture items, radiochemistry and radiation legislation, and practical course. Radiochemistry course will describe nature of radioactivity, decay types, interaction of radiation with matter and biological effects of ionizing radiation. In the legislation part radiation law and regulatory guides on radiation safety will be examined. During the practical course students will be familiarized with the use of radioisotopes, radiation protection and radiation safety rules. They will also be familiarized with some typical ways to use radiation in research work. Passing the lecture part not less than 3 (and the legislation part at least 3) and completion of practical course will qualify to act as a radiation safety officer (radiation law 592/91 18§) in the following fields of competence: 1) Use of unsealed sources in industry, research and education, 2) Use of sealed sources and X-ray appliances in industry, research and education, 3) Trade in radioactive substances.

**Mode of delivery:** Face to face teaching

**Learning activities and teaching methods:** Course is organized in co-operation with Department of Physics. 26 h lectures, 8 h exercises, 2 practicals with sealed radiation sources, 40 h lab

**Target group:** Major students

**Prerequisites and co-requisites:** Biochemical methodologies I, Metabolism I and Molecular biology I

**Recommended optional programme components:** -

**Recommended or required reading:** Lecture handout, Radiation act and Radiation degree, Regulatory Guides on radiation safety, laboratory manual

**Assessment methods and criteria:** Laboratory practicals, final exam Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:** 1-5/fail

**Person responsible:** Sakari Kellokumpu

**Working life cooperation:** No

**Other information:** Location of instruction: Lectures: Linnanmaa, laboratory: Kontinkangas

#### 740371A Fysiologinen biokemia (4cp)

Physiological Biochemistry

**ECTS Credits:** 4 credits

**Language of instruction:** English

**Timing:** B.Sc. yr3 spring

- **Learning outcomes:** Aim of the course is to get students familiar with: Specific aspects of human biochemistry
- Structure, tasks and function of different organs
- Systemic and intracellular regulation of metabolism
- Functional and regulatory relations of different organs

**Contents:** Lectures include information about morphology, function and role in metabolism of adipose tissue, kidney, muscle tissue and cytoskeleton, alimentary system and liver. They also focus on structure of biomembranes, composition

and function of endocrine system, hormone synthesis and signal transduction. Mechanisms of action of hormones (especially steroid hormones), their cell surface and intracellular receptors, second messengers and other regulatory molecules will be discussed.

**Mode of delivery:** Face to face teaching

**Learning activities and teaching methods:** 18 h lectures, 4 h seminars, and 10 h laboratory work. Seminars and laboratory work are compulsory.

**Target group:** Major students

**Prerequisites and co-requisites:** Basic biochemistry, cellular and molecular biology

**Recommended optional programme components:** Alternative course: 7513823A Animal physiology, lectures 5 op

**Recommended or required reading:** Murray et al. Harpers' Illustrated Biochemistry (28 or 29 th edition)

**Assessment methods and criteria:** Final exam Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:** 1-5/fail

**Person responsible:** Kalervo Hiltunen

**Working life cooperation:** No

**Other information:** Recommended optional course. Location of instruction: Kontinkangas

### 740376A Biokemian opinnäyte (LuK-tutkielma) (10cp)

Essay (B.Sc. thesis)

**ECTS Credits:** 10 credits

**Language of instruction:** Finnish

**Timing:** B.Sc. yr3 autumn

**Learning outcomes:** Students should be able to execute a project to produce a thesis type of output, be well aware of current research trends in biochemistry, be able to critically select knowledge from the literature, be able to discuss and debate scientific results, and be able to choose and evaluate proper form of presentation for each purpose.

**Contents:** The theme of the module is public understanding of science and the reporting of biochemical research using different methods and for different audiences. During the course students will learn on a general level about different fields of biochemistry and their specific questions, orientation of biochemical research and organization of research into projects. Practical exercises will contain presenting of a given subject in different forms, which may be a talk, a short article, a poster, a press release or a research proposal. A literature report will be written as well as a popularized presentation of it. In addition the course is linked to the module Ruotsin kieli (Swedish language).

**Mode of delivery:** Face to face teaching

**Learning activities and teaching methods:** about 50 h lectures, seminars, small groups and practicals, also self study and student presentations

**Target group:** Major students

**Prerequisites and co-requisites:** Course is for BSc yr3 students

**Recommended optional programme components:** Information skills 030005P is recommended for completion simultaneously.

**Recommended or required reading:** -

**Assessment methods and criteria:** Writing and presentation of BSc thesis. Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:** pass/fail

**Person responsible:** Tuomo Glumoff

**Working life cooperation:** No

**Other information:** Location of instruction: Kontinkangas

### 740379A Johdatus immunologiaan (3cp)

Introduction to immunology

**ECTS Credits:** 3 credits

**Language of instruction:** English

**Timing:** B.Sc. yr3 autumn or M.Sc yr1-yr2 autumn

**Learning outcomes:** After the course students will be able to identify, analyze and apply essential cellular molecules, components and mechanisms related to immunology, and complete their previous knowledge of molecular and cellular biology and protein chemistry with immunobiochemistry issues.

**Contents:** The course handles both unspecific and specific immune response mechanisms, antibody structure and diversity, antibody-based immunodiagnostics, as well as basics of virus biochemistry.

**Mode of delivery:** Face to face teaching

**Learning activities and teaching methods:** Lectures (12 h), a written home exercise, and a final exam.

**Target group:** Major and minor subject undergraduates

**Prerequisites and co-requisites:** Preliminary required courses: Molekyylibiologia I, Protein chemistry I and Solun biologia, or equivalent basic molecular biology, protein chemistry and cell biology studies.

**Recommended optional programme components:** -

**Recommended or required reading:** -

**Assessment methods and criteria:** Home exercise, final exam Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:** 1-5/fail

**Person responsible:** Valerio Izzì

**Working life cooperation:** No

**Other information:** This module is the same as 743660S Introduction to immunology. Location of instruction: Kontinkangas campus.

### 740380A Virology (3cp)

Virology

**ECTS Credits:** 3 credits

**Language of instruction:** English

**Timing:** BSc. yr3 spring

- **Learning outcomes:** 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:** 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 and 10h seminars where the students should be able to recapitulate major aspects of the taught material in 5-7 min presentations.

**Mode of delivery:** Face to face teaching

**Learning activities and teaching methods:** 24 h lectures and student presentations in seminars

**Target group:** Major students

**Prerequisites and co-requisites:** Cellular biology

**Recommended optional programme components:** -

**Recommended or required reading:** -

**Assessment methods and criteria:** Final exam Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:** 1-5/fail

**Person responsible:** Thomas Kietzmann

**Working life cooperation:** No

**Other information:** This module is the same as Virology (743661S). Location of instruction: Kontinkangas

### 740381A Biochemical and biomedical innovation (2-5cp)

Biochemical and biomedical innovation

**ECTS Credits:** 2-5 credits



**Language of instruction:** English

**Timing:** Can be taken by any BSc / MSc / PhD student

- **Learning outcomes:** The aim of the course is to get student familiar with: the core skill set required to recognize opportunities/needs and how to validate creative ideas
- the core skill set of searching patent databases
- the concepts of intellectual property rights (IPR)
- the concepts of how to pitch an idea

**Contents:** This module covers basic aspects of the key skills required for successful innovation in the field of biochemistry and molecular medicine. Concepts relating to how to recognize opportunities, how to recognize what is needed in the field, creative thinking, validating ideas and how to pitch ideas are covered as well as an introduction to intellectual property rights and patent searching. In addition to workshops/seminars (19 hours) the 5 ECTS version of course requires submission of an invention disclosure/proof of concept funding or submission of an entry to the biochemistry and molecular medicine innovation award.

**Mode of delivery:** Face to face teaching

**Learning activities and teaching methods:** 19 hours of lectures/workshops

**Target group:** Major students

**Prerequisites and co-requisites:** None

**Recommended optional programme components:** -

**Recommended or required reading:** -

**Assessment methods and criteria:** For 2 ECTS participation in at least 70% of seminars/workshops. For 5 ECTS participation in at least 70% of the seminars/workshops plus submission of an invention disclosure / proof of concept funding application to the university (PhD students) or submission of an entry to the biochemistry and molecular medicine innovation award (BSc and MSc students).

**Grading:** Pass/fail

**Person responsible:** Lloyd Ruddock

**Working life cooperation:** No

**Other information:** Location of instruction: Kontinkangas campus

#### 740382A Orientation to biochemical work (0-6cp)

Orientation to biochemical work

**ECTS Credits:** 0-6 credits

**Language of instruction:** Finnish/English

**Timing:** BSc yr1-2

- **Learning outcomes:** 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:** 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 1.5op being awarded for each full-time week equivalent worked. A maximum of 6op can be awarded for working in one work placements. Each placement must be agreed in advance with the responsible person.

**Mode of delivery:** Face to face teaching

**Target group:** Major students

**Prerequisites and co-requisites:** -

**Recommended optional programme components:** -

**Recommended or required reading:** -

**Assessment methods and criteria:** Non-research work

**Grading:** Pass/fail

**Person responsible:** Jari Heikkinen

**Working life cooperation:** Yes

**Other information:** Optional course. The maximum sum of credits from courses 740382A and 740383A is 6 credits

#### 740383A Orientation to research work (0-6cp)

Orientation to research work

**ECTS Credits:** 0-6 credits

**Language of instruction:** Finnish/English

**Timing:** BSc yr1-3

- **Learning outcomes:** **Learning outcomes:** 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:** 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 1.5op being awarded for each full-time week equivalent worked. A maximum of 6op can be awarded for working 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.

**Mode of delivery:** Face to face teaching

**Target group:** Major students (BSc)

**Prerequisites and co-requisites:** -

**Recommended optional programme components:** -

**Recommended or required reading:** -

**Assessment methods and criteria:** Research work

**Grading:** Pass/fail

**Person responsible:** Jari Heikkinen

**Working life cooperation:** Yes

**Other information:** Optional course. The maximum sum of credits from courses 740382A and 740383A is 6 credits.

## Courses for minor subject students

#### 740147P Biomolecules for Bioscientists (8cp)

Biomolecules for Bioscientists

**ECTS Credits:** 8 credits

**Language of instruction:** English

**Timing:** autumn-spring

- **Learning outcomes:** Upon successful completion students are able to: tell the composition, structure and function of the major groups of biomolecules in cells; nucleic acids,
- proteins, carbohydrates and lipids and describe the forces that modulate their function.
- apply information in the right context and evaluate it critically
- In addition, students on the 8op versions are able to work in the biochemical laboratory, are able to solve calculations and problems and are able to interpret the scientific data they generate

**Contents:** This module provides an overview of biochemistry, outlining the forces involved in biomolecule structure and the chemical structures and properties of polynucleic acids, proteins, carbohydrates and lipids. There will also be an introduction to prebiotic evolution and a student debate on this subject. The module is arranged into lectures, workshops, a student debate and laboratory work. All of the exercises are in English. Both a final examination and continuous assessment will count towards the final mark and attendance of some parts is compulsory.

**Mode of delivery:** Face to face teaching

**Learning activities and teaching methods:** 30 h lectures, 48 h lab., plus exercises

**Target group:** Minor subject students

**Prerequisites and co-requisites:** -

**Recommended optional programme components:** -

**Recommended or required reading:** Mathews, van Holde & Ahern: Biochemistry, (3rd edition), published by Addison Wesley Longman, Inc. or equivalent

**Assessment methods and criteria:** Continuous assessment, final examination Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:** 1-5/fail

**Person responsible:** Tuomo Glumoff

**Working life cooperation:** No

**Other information:** This module is the same as Biomolecules for Biochemists except that there is the option for one of the exercises to be in Finnish. Location of instruction: Lectures: Linnanmaa, laboratory: Kontinkangas

#### 740148P Biomolecules (5cp)

Biomolecules

**ECTS Credits:** 5 credits

**Language of instruction:** English

**Timing:** autumn-spring

- **Learning outcomes:** Upon successful completion students are able to: tell the composition, structure and function of the major groups of biomolecules in cells; nucleic acids, proteins, carbohydrates and lipids and describe the forces that modulate their function.
- apply information in the right context and evaluate it critically

**Contents:** This module provides an overview of biochemistry, outlining the forces involved in biomolecule structure and the chemical structures and properties of polynucleic acids, proteins, carbohydrates and lipids. There will also be an introduction to prebiotic evolution and a student debate on this subject. The module is arranged into lectures, workshops, a student debate. All of the exercises are in English. Both a final examination and continuous assessment will count towards the final mark and attendance of some parts is compulsory.

**Mode of delivery:** Face to face teaching

**Learning activities and teaching methods:** 30 h lectures, plus exercises

**Target group:** Minor subject students

**Prerequisites and co-requisites:** -

**Recommended optional programme components:** -

**Recommended or required reading:** Mathews, van Holde & Ahern: Biochemistry, (3rd edition), published by Addison Wesley Longman, Inc. or equivalent

**Assessment methods and criteria:** Continuous assessment, final examination Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:** 1-5/fail

**Person responsible:** Tuomo Glumoff

**Working life cooperation:** No

**Other information:** This module is the same as Biomolecules for Biochemists except that it contains no practical component. Location of instruction: Linnanmaa campus

#### 740149P Aineenvaihdunta I (4cp)

Metabolism I

**ECTS Credits:** 4 credits

**Language of instruction:** Finnish

**Timing:** spring

**Learning outcomes:** Students will be able to explain the main principles of how the metabolism is made up, will get a detailed picture of the energy metabolism, and will be able to organize part of the wholeness of metabolism, particularly how energy metabolism is networked to the synthesis and degradation of biomolecules.

**Contents:** On this course the central concepts and mechanisms of metabolism, its regulation and the

integration of metabolic pathways will be introduced, like anabolism and catabolism, linking of different pathways, and metabolic regulation. Especially the energy metabolism will be studied, concerning carbohydrates, lipids and the respiratory chain. Combined with the course Metabolism II the students will get a good overview on the principles of metabolism, metabolic integration and the methods to study metabolism.

**Mode of delivery:** Face to face teaching

**Learning activities and teaching methods:** Lectures (28 h), problem-based exercises (workshops) 6 h and final exam.

**Target group:** Minor subject students

**Prerequisites and co-requisites:** Biomolecules for Biochemists or Biomolecules for Bioscientists or Biomolecules

**Recommended optional programme components:** -

**Recommended or required reading:** -

**Assessment methods and criteria:** Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:** 1-5/fail. Problem-based exercises and a final exam will count towards the final grade.

**Person responsible:** Tuomo Glumoff

**Working life cooperation:** -

**Other information:** This module is the same as Metabolism I (740146P), except that it contains no laboratory component. **Location of instruction:** Linnanmaa

#### 740373A Molekyylibiologia I (4cp)

Molecular Biology I

**ECTS Credits:** 4 credits

**Language of instruction:** Finnish

**Timing:** autumn

**Learning outcomes:** After this course students should understand modern molecular biology methods.

**Contents:** The course covers gene structure, DNA replication, recombination, transcription and translation. The student will learn the most common recombinant DNA techniques, such as PCR, use of restriction endonucleases, preparation of recombinant plasmids and DNA sequencing.

**Mode of delivery:** Face to face teaching

**Learning activities and teaching methods:** 20 h lectures, 4 h computer exercise and homeworks

**Target group:** Minor subject students

**Prerequisites and co-requisites:** -

**Recommended optional programme components:** -

**Recommended or required reading:** Mathews, CK, van Holde KT, Applins DR, Anthony-Cahill SJ: Biochemistry (4th edition). Optional.

**Assessment methods and criteria:** Homeworks 50%, final exam 50% Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:** 1-5/fail.

**Person responsible:** Mirva Saaranen and Aki Manninen

**Working life cooperation:** no

**Other information:** This course is the same as Molecular biology I (740361A) but without practical part. **Location of instruction:** Linnanmaa

#### 740374A Mikrobiologia (3cp)

Microbiology

**ECTS Credits:** 3 credits

**Language of instruction:** English

**Timing:** spring

- **Learning outcomes:** Upon successful completion students are able to: define the typical features of bacteria, archaea, fungi and virus and explain the diversity of different groups of microorganisms
- explain the basic aspects of microbial metabolism

- understand the basics of microbial growth, enrichment, culture and growth control both in the environment and in contained culture
- explain the essential roles of microorganisms in our environment
- apply their knowledge for the growth and its control of standard laboratory microorganisms
- have a basic understanding of the industrial use of microorganisms or microbial compounds.

**Contents:** This module is an introduction to general and applied microbiology and consists of lecture and laboratory exercises. In the lectures, the diversity and classification of micro organisms, especially bacteria will be introduced. Further topics are the structure and function of the prokaryotic cell, bacterial growth, metabolism and physiology, the importance of bacteria in different ecosystems as well as the industrial use of bacteria.

**Mode of delivery:** Face to face teaching

**Learning activities and teaching methods:** 24 h lectures

**Target group:** Minor subject students

**Prerequisites and co-requisites:** -

**Recommended optional programme components:** -

**Recommended or required reading:** M. Salkinoja-Salonen (toim.) (2002) Mikrobiologian perusteita, Helsingin yliopisto; M.T. Madigan, J. M. Martinko, J. Parker (2010) Brock biology of microorganisms, 13th ed. Prentice Hall International.

**Assessment methods and criteria:** Continuous assessment (home works), final exam Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:** 1-5/fail

**Person responsible:** Helmut Pospiech

**Working life cooperation:** No

**Other information:** This module is the same as Microbiology (740363A) except that it contains no practical component. Location of instruction: Linnanmaa campus

## B.Sc. Degree

### Courses from other Degree programmes (obligatory or recommended optional)

#### 030005P Tiedonhankintakurssi (1cp)

Information Skills

**ECTS Credits:** 1 ECTS credit

**Language of instruction:** Finnish

**Timing:** 2nd or 3rd year

**Learning outcomes:** Students know the different phases of information retrieval process and basic techniques of scientific information retrieval. They will find the most important reference databases of their discipline and know how to evaluate information sources and retrieval results.

**Contents:** Retrieval of scientific information, the retrieval process, key databases of the discipline, and evaluation of information retrieval and information sources.

**Mode of delivery:** Blended teaching: classroom training, web-based learning material and exercises in Optima environment, a final assignment on a topic of the student's own choice

**Learning activities and teaching methods:** Training sessions 8h, group working 7h, self-study 12h

**Target group:** Compulsory for all students of the Faculty of Technology, the Faculty of Information Technology and Electrical Engineering and the Faculty of Architecture. In the Faculty of Science compulsory for students of biology,

physics, geosciences, chemistry and geography. Optional for students of biochemistry and mathematics.

**Prerequisites and co-requisites:** -

**Recommended optional programme components:** -

**Recommended or required reading:** Web learning material <https://wiki oulu.fi/display/030005P>.

**Assessment methods and criteria:** Passing the course requires participation in the training sessions and successful completion of the course assignments. Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:** pass/fail

**Person responsible:** Science and Technology Library Tellus, tellustieto (at) oulu.fi

**Working life cooperation:** -

**Other information:** -

#### 040911S Eläinten käyttäminen tutkimuksessa - kurssi toimenpiteiden suorittajalle (3cp)

Using animals in research - carrying out procedures

#### 750121P Solubiologia (5cp)

Cell biology

**ECTS Credits:** 5 ECTS credits / 133 hours of work.

**Language of instruction:** Finnish.

**Timing:** B.Sc. 1 st autumn.

**Learning outcomes:** The student is familiar with cellular structure and functioning in plant and animal cells, understands the social structures in multicellular species and knows why and how the genetic organizations (in nucleus, chloroplast and mitochondria) are co-operating, maintaining and regulating the cellular metabolism. Student understands the common origin and evolution of life on planet Earth, and understands the material basis and mechanisms of this continuity.

**Contents:** During the recent years especially the development of molecular and microscopic and imaging techniques has increased our knowledge on cells and their social interactions. The structural and functional characteristics of plant and animal cells will be covered as well as the genetic organization maintaining and regulating the system.

**Mode of delivery:** Face-to-face teaching.

**Learning activities and teaching methods:** 72 h lectures, three exams (zoology, botany, genetics). Home essays and internet material.

**Target group:** Compulsory to the biology and biochemistry students.

**Prerequisites and co-requisites:** Good basics in biology from elementary school.

**Recommended optional programme components:** Cell biology is prerequisite for the following courses: Developmental biology-histology lectures and exercises (751367A, 755317A), Animal physiology lectures and exercises (751388A, 755318A), Functional plant biology lectures and exercises (752345A, 756341A), Concepts of genetics (753124P). Course also gives readiness for studies in molecular biology and biochemistry.

**Recommended or required reading:** Textbooks Alberts, B. et al. 2008: Molecular Biology of the Cell (5e). Garland Science Publishing, London, 1268 p. ISBN: 0815341067. (Lodish et al. 2008: Molecular Cell Biology (6e). Freeman, New York, 1150 p.). The availability of the literature can be checked from [this link](#). The availability of the literature can be checked from [this link](#).

**Assessment methods and criteria:** Three exams. Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:** 1-5 / Fail. Final grade is average value of the three

exams.

**Person responsible:** Prof. Seppo Saarela, Prof. Hely Häggman and Dr. Helmi Kuittinen.

**Working life cooperation:** No.

**Other information:** -

### 755320A Kehitysbiologia-histologia, luennot (5cp)

Developmental biology-histology, lectures

**ECTS Credits:** 5 ECTS credits / 133 hours of work.

**Language of instruction:** Finnish.

**Timing:** B.Sc. 1 st spring.

**Learning outcomes:** After completing the developmental biology -part of the course the student is able to name the most important events of embryonic development and the structural changes related to them. The student is also able to describe the principles gene regulation related to embryonic development. After completing the histology-part of the course the student is able to describe the various tissue types and the microscopic structure of important organs and is also able to identify tissue types and organs from microscopic sections.

**Contents:** Motto: "It is not birth, marriage, or death, but gastrulation, which is truly the most important time in your life." (Lewis Wolpert, 1986). Developmental biology will cover gametogenesis, fertilization, forming of embryonic tissue layers (gastrulation), embryonic induction, signal molecules and the differentiation of the most important tissues and organs (organogenesis). Histology will first cover various tissue types, their cell types and matrix composition. Thereafter, the microscopic structure and tissue composition of various organs and organ systems will be covered. In both parts, practical exercises on drawing from microscopic slides (see 755317A) will support lectures.

**Mode of delivery:** Face-to-face teaching.

**Learning activities and teaching methods:** 38 h lectures and two exams.

**Target group:** Compulsory to biology students.

**Prerequisites and co-requisites:** Cell biology (750121P) or equivalent knowledge.

**Recommended optional programme components:** -

**Recommended or required reading:** Lecture notes, lecture handouts. Recommended reading: Sariola, Frilander ym., Solusta yksilöksi: Kehitysbiologia, Duodecim, Helsinki 2003; Gilbert: Developmental Biology, Sinauer Press, 6.ed. 2000, or newer; Young & Heath: Wheater's Functional Histology, Churchill Livingstone, 4. ed. 2000, or newer. The availability of the literature can be checked from [this link](#).

**Assessment methods and criteria:** 2 lecture exams. Read more about [assessment criteria](#) at the University of Oulu webpage. Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:** 1-5 / Fail.

**Person responsible:** Prof. Esa Hohtola.

**Working life cooperation:** No.

**Other information:** -

### 755323A Eläinfysiologia luennot (5cp)

Animal physiology lectures

**ECTS Credits:** 5 ECTS credits / 133 hours of work.

**Language of instruction:** Finnish.

**Timing:** B.Sc. 2nd spring.

**Learning outcomes:** After completing the course the student is able to form a general view of animal body functions, the regulation of organ systems, and the background of human health and diseases.

**Contents:** Course focus on the basic problematic of physiological themes including nervous system, muscles, circulation, nutrition, metabolism, immune system, hormones and reproduction physiology.

**Mode of delivery:** Face-to-face teaching.

**Learning activities and teaching methods:** 50 h lectures and independent studying, mid-semester exams, home

essays.

**Target group:** Compulsory to the biology students.

**Prerequisites and co-requisites:** Cell biology (750121P) or equivalent knowledge.

**Recommended optional programme components:** This course is a prerequisite for the courses Animal physiology, exercises (755318A), Comparative animal physiology (751x84A/S) and Advanced course in animal physiology (751635S).

**Recommended or required reading:** Reece, J.B. Urry, L.A. Cain, M.L., Wasserman, S.A. Minorsky, P.V. & Jackson R.B. 2011: Campbell Biology (9e). Pearson, Global Edition, 1309 p, handouts. The availability of the literature can be checked from [this link](#).

**Assessment methods and criteria:** Home essays and exam. Read more about [assessment criteria](#) at the University of Oulu webpage. Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:** 1-5 / Fail.

**Person responsible:** Prof. Esa Hohtola.

**Working life cooperation:** No.

**Other information:** -

### 755327A Eläinfysiologian harjoitukset (5cp)

Animal physiology exercises

**ECTS Credits:** 5 ECTS credits / 133 hours of work.

**Language of instruction:** Finnish.

**Timing:** B.Sc. 3 rd autumn.

**Learning outcomes:** Students know basic physiological methods and can design simple experiments.

**Contents:** The laboratory course will familiarize students with the use of simple experimental trials, laboratory tests and computer aided measurements the physiological basic principles.

**Mode of delivery:** Face-to-face teaching.

**Learning activities and teaching methods:** 32 h laboratory training, exam.

**Target group:** BS compulsory, TEAbs optional.

**Prerequisites and co-requisites:** Cell biology (750121P) and Animal physiology, lectures (751388A).

**Recommended optional programme components:** This course is a prerequisite for the courses Comparative animal physiology (751x84A/S), and Advanced animal physiology (751635S).

**Recommended or required reading:** Animal physiology course booklet.

**Assessment methods and criteria:** Exam. Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:** 1-5 / Fail.

**Working life cooperation:** No.

**Other information:** -

### 757122P Genetiikan perusteiden luennot biokemisteille (3cp)

Concepts of genetics for biochemists

**Assessment methods and criteria:** Read more about [assessment criteria](#) at the University of Oulu webpage.

### 780116P Johdatus orgaaniseen kemiaan (5cp)

Introduction to Organic Chemistry

**ECTS Credits:** 5 credits /134 hours of work

**Language of instruction:** Finnish. Book-examination in English as well.

**Timing:** 1st autumn and 1st spring

**Learning outcomes:** After this course, the student can explain organic chemistry fundamentals, basic concepts and terminology, can use them for the description of organic chemistry phenomena. He/she can name organic structures, explain their properties, deduce basic reaction types and solve their mechanisms.



**Contents:** Basic reactions of organic compounds, basic principles of stereochemistry and reaction mechanisms: Addition, elimination, substitution, including electrophilic aromatic substitution, reactions of carbonyl group. Applications.

**Mode of delivery:** Face-to-face teaching

**Learning activities and teaching methods:** 40 hours of lectures plus 10 hours of exercises, 84 hours of independent self-study

**Target group:** Biochemistry, Chemistry, Biology, Process Engineering, Environmental Engineering and in the study entity of 25 credits, compulsory. Physical Sciences, Geology, Geography, Mathematical Sciences, optional.

**Prerequisites and co-requisites:** Upper secondary school chemistry

**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:** Hart, H., Hart, D.J. and Craine, L.E.: Organic Chemistry: A Short Course, 10th ed. or the newer edition, Houghton Mifflin Boston, 1999; Hart, H., Hart, D.J. and Craine, L.E.: Study Guide & Solutions Book, Organic Chemistry: A Short Course, 10th ed. or the newer edition, Houghton Mifflin Boston, 1999.

**Assessment methods and criteria:** Two intermediate examinations or one final examination. Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:** The course utilizes a numerical grading scale 0-5. In the numerical scale zero stands for a fail.

**Person responsible:** PhD Johanna Kärkkäinen

**Working life cooperation:** No

**Other information:** No

#### 780117P Yleinen ja epäorgaaninen kemia A (5cp)

General and Inorganic Chemistry A

**ECTS Credits:** 5 credits /134 hours of work

**Language of instruction:** Finnish

**Timing:** 1st autumn

**Learning outcomes:** After this course the student should understand basic concepts of chemistry as described in international general chemistry curriculum.

**Contents:** Basic concepts of chemistry, chemical formula, chemical reaction, chemical equation, oxidation-reduction reactions, stoichiometry, gases, chemical equilibrium, acids and bases, additional aspects of acid-base equilibria, solubility and complex-ion equilibria.

**Mode of delivery:** Face-to-face teaching

**Learning activities and teaching methods:** 32 hours of lectures and applications, 20 hours of exercises and 82 hours of self-study

**Target group:** Biochemistry, Chemistry compulsory. In the entity of 25 credits (minor studies), compulsory. Physical sciences, Mathematical sciences, optional.

**Prerequisites and co-requisites:** Upper secondary school chemistry

**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:** Petrucci, R.H., Her-ring, F.G., Madura, J.D. ja Bissonnette, C.: General Chemistry: Principles and Modern Applications, 10. edition (also 7., 8. and 9. edition), Pearson Canada Inc., Toronto, 2011. Chapters 1 – 6, 15 – 18.

**Assessment methods and criteria:** Two intermediate examinations or one final examination. Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:** The course utilizes a numerical grading scale 0-5. In the numerical scale zero stands for a fail.

**Person responsible:** N.N.

**Working life cooperation:** No

**Other information:** No

#### 780118P Yleinen ja epäorgaaninen kemia B (5cp)

General and Inorganic Chemistry B

**ECTS Credits:** 5 credits /134 hours of work

**Language of instruction:** Finnish

**Timing:** 1st autumn

**Learning outcomes:** After this course the student should understand basic concepts of chemistry as described in international general chemistry curriculum.

**Contents:** Thermodynamics, reaction kinetics, electrochemistry, electrons in atoms, periodic table, chemical bond, intermolecular forces.

**Mode of delivery:** Face-to-face teaching

**Learning activities and teaching methods:** 36 hours of lectures and applications, 22 hours of exercises, 82 hours of self-study

**Target group:** Biochemistry, Chemistry, compulsory. In the entity of 25 credits (minor studies), compulsory. Physical sciences, Mathematical sciences, optional.

**Prerequisites and co-requisites:** Upper secondary school chemistry

**Recommended optional programme components:** -

**Recommended or required reading:** Petrucci, R.H., Her-ring, F.G., Madura, J.D. ja Bissonnette, C.: General Chemistry: Principles and Modern Applications, 10. edition (also 7., 8. and 9. edition), Pearson Canada Inc., Toronto, 2011. Chapters 7 – 12.1, 12.5 – 12.7, 14, 19 – 20.

**Assessment methods and criteria:** Two intermediate examinations or one final examination. Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:** The course utilizes a numerical grading scale 0-5. In the numerical scale zero stands for a fail.

**Person responsible:** N.N.

**Working life cooperation:** No

**Other information:** No

#### 780119P Johdatus analyttiseen kemiaan (5cp)

Introduction to Analytical Chemistry

**ECTS Credits:** 5 credits /134 hours of work

**Language of instruction:** Finnish

**Timing:** 2nd autumn

**Learning outcomes:** Upon completion the student should have acquired knowledge and understanding of basic concepts of quantitative chemical analysis employing classical methods of analysis.

**Contents:** Steps in quantitative analysis, statistical evaluation of analytical data, chemical equilibrium in aqueous solutions, gravimetry, titrimetry, spectrophotometry.

**Mode of delivery:** Face-to-face teaching

**Learning activities and teaching methods:** 30 hours of lectures + 20 hours of exercises + 83 hours of self-study

**Target group:** Chemistry, compulsory. In the study entity of 25 credits compulsory.

**Prerequisites and co-requisites:** General and Inorganic Chemistry A (780117P) and General and Inorganic Chemistry B (780118P), or General and Inorganic Chemistry I (780114P) and General and Inorganic Chemistry II (780115P), or Introduction to Chemistry (780113P), or Basic Principles in Chemistry (780109P).

**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:** Saarinen, H. ja Lajunen, L.H.J.: Analyttisen kemian perusteet, Oulun yliopistopaino, 2004.

**Assessment methods and criteria:** Two intermediate examinations or one final examination. Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:** The course utilizes a numerical grading scale 0-5. In the numerical scale zero stands for a fail.

**Person responsible:** Prof. Paavo Perämäki

**Working life cooperation:** No

**Other information:** No

**780123P Kemian perustyöt (5cp)**  
Introductory Laboratory Works in Chemistry

**ECTS Credits:** 5 credits /134 hours of work

**Language of instruction:** Finnish

**Timing:** 1st autumn or 1st spring

**Learning outcomes:** After this course, the student can apply laboratory safety instructions and act accordingly. He/she can communicate by using basic laboratory terminology and work in a group under the guidance. The student identifies basic laboratory equipment and can use them properly. He/she recognizes the importance of the planning of the laboratory work. The student is able to utilize the basic chemistry techniques and determination methods in the given task. Furthermore, the student can also make laboratory notes and write a report on the performed task.

**Contents:** Laboratory safety, basic laboratory equipment, basic chemistry techniques and determination methods as well as some of their theoretical background, problems related to the studied determination methods, keeping a laboratory notebook, writing a report.

**Mode of delivery:** Supervised laboratory work, independently done preparatory problems.

**Learning activities and teaching methods:** Safety in laboratory 2 hours, 40 hours of laboratory work + demonstrations + problems, 92 hours of self-study.

**Target group:** Biochemistry, Process Engineering, Environmental engineering, compulsory. In the entity of 25 credits, compulsory. Physical Sciences, Geology, Mathematical Sciences, optional.

**Prerequisites and co-requisites:** Basic Principles in Chemistry (780120P, 5cr) or Basic Principles in Chemistry (780109P, 4 cr) or General and Inorganic Chemistry A (780117P, 5 cr). Student is allowed to participate to the course simultaneously when participating the prerequisites. Attendance at the lecture of Safety in laboratory is compulsory.

**Recommended optional programme components:** Participation in the courses Basic Principles of Chemistry (780123P, 5 cr), General and Inorganic Chemistry A (780117P, 5 cr) and Introduction to Organic Chemistry (780116P, 5 cr).

**Recommended or required reading:** Instruction Book (in Finnish): Kemian perustyöt 780123P

**Assessment methods and criteria:** Accomplishment of the course requires accepted preparatory problems, laboratory exercises, problems related to them and final examination. Laboratory exercises and final examination has to be completed within next two terms. Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:** The course utilizes verbal grading scale pass/fail.

**Person responsible:** Ph.D. Teija Kangas

**Working life cooperation:** No

**Other information:** Attendance at the lecture of Safety at work is compulsory. The exercises must be done before each laboratory assignment. Deadline of the written report is binding. Failure will lead to the renewal of the work.

**781305A Orgaaninen kemia I (5cp)**

Organic Chemistry I

**ECTS Credits:** 5 credits /134 hours of work

**Language of instruction:** Finnish

**Timing:** 2nd autumn

**Learning outcomes:** After passing the course the student can explain the basics in molecular orbitals in simple organic compounds such as ethane, details in nucleophilic substitution, conformation and the basics in stereochemistry of organic compounds.

**Contents:** Including molecular orbitals in organic compounds, conformation theory, nucleophilic substitution and basics of stereochemistry.

**Mode of delivery:** Face-to-face teaching

**Learning activities and teaching methods:** 40 hours of lectures, 94 hours self study

**Target group:** Chemistry, compulsory. In the entity of 60 credits, compulsory.

**Prerequisites and co-requisites:** Introduction to Organic Chemistry (780103P or 780116P) and the courses General and Inorganic Chemistry A (780117P) and General and Inorganic Chemistry B (780118P); or the courses General and Inorganic Chemistry I (780114P) and General and Inorganic Chemistry II (780115P); OR Introduction to Chemistry (780113P) or Introduction to Physical Chemistry (780101P).

**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:** Clayden, J., Greeves, N., Warren, S., Wothers, P.: Organic Chemistry, Oxford University Press, 2001 and Clayden, J., Greeves, N., Warren, S.: Organic Chemistry, Oxford University Press, 2nd Edition, 2012.

**Assessment methods and criteria:** Two intermediate examinations or one final examination Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:** The course utilizes a numerical grading scale 0-5. In the numerical scale zero stands for a fail.

**Person responsible:** N.N.

**Working life cooperation:** No

**Other information:** No

**781307A Orgaanisen kemian laboratorioharjoitukset I (5cp)**

Laboratory Course I in Organic Chemistry

**ECTS Credits:** 5 credits /134 hours of work

**Language of instruction:** Finnish, English on demand, materials in English (partly)

**Timing:** 2nd autumn

**Learning outcomes:** Upon completion of the five different syntheses of the course, the student is familiar with safety issues, glassware and equipment, use of laboratory notebook and reporting of laboratory experiments. He/she should be able to work by using basic techniques of organic chemistry such as distillation, extraction, crystallization, TLC.

**Contents:** Five different organic syntheses.

**Mode of delivery:** Face-to-face teaching in the laboratory

**Learning activities and teaching methods:** 4 h lectures (obligatory for all), 52h laboratory of supervised, independent laboratory work and 78 h self-study and reporting.

**Target group:** Chemistry, compulsory

**Prerequisites and co-requisites:** General and Inorganic Chemistry A and General and Inorganic Chemistry B (780117P and 780118P), Introduction to Organic Chemistry (780116P), and Introductory Laboratory Course (780123P/780127P) passed. Or General and Inorganic Chemistry I and General and Inorganic Chemistry II (780114P and 780115P), or Introduction to Chemistry (780113P) or Introduction to Physical Chemistry (780101P) and Introduction to Inorganic Chemistry (780102P) or Basic Principles in Chemistry (780109P), Introduction to Organic Chemistry (780103P), and Introductory Laboratory Course (780122P or 780123P) passed.

**Recommended optional programme components:** Participation in the course 781305A Organic Chemistry I.

**Recommended or required reading:** Laboratory Course Manual. Clayden, J., Greeves, N., Warren, S., and Wothers, P.: Organic Chemistry, Oxford University Press, 2001 or Clayden, J., Greeves, N., Warren, S.: Organic Chemistry, Oxford University Press, 2nd edition, 2012.

**Assessment methods and criteria:** Works, reports and the preliminary exam passed. The works must be done within the next two years. Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:** The course utilizes a numerical grading scale 0-5. In the numerical scale zero stands for a fail.  
**Person responsible:** PhD Juha Heiskanen  
**Working life cooperation:** No  
**Other information:** The reports must be returned to the teacher by the given deadline. Otherwise you have to do the work again.

### 806118P Johdatus tilastotieteeseen (5cp)

Introduction to Statistics

**ECTS Credits:** 5 ECTS credits

**Language of instruction:** Finnish

**Timing:** 3rd period

**Learning outcomes:** After completing the course, student will be able to - consider issues influencing to data collection - describe data by appropriate methods (tables, statistics and graphical presentations) - evaluate the effect size of the sample to the margin of error for instance in Gallup polls and in different market researches - interpret output of a statistical software.

**Contents:** - collecting data, e.g. sampling - variables and measuring - descriptive statistical methods and their selection - margin of error of estimator for population mean and proportion - statistical literacy - basic analysis of data using statistical software

**Mode of delivery:** Face-to-face teaching

**Learning activities and teaching methods:** Total 50 h face-to-face teaching including lectures and exercise (partly computer exercises). Independent work 83 h.

**Target group:** Minor students

**Recommended optional programme components:** After the course, student is able to continue other statistics courses.

**Recommended or required reading:** Lecture notes

**Assessment methods and criteria:** Mid-term exams and/or final exam and possible homework.

**Grading:** Fail, 1-5

**Person responsible:** Jari Päckilä

**Working life cooperation:** No

**Other information:** -

### 806119P Tilastotieteen jatkokurssi (5cp)

A Second Course in Statistics

**ECTS Credits:** 5 ECTS credits

**Language of instruction:** Finnish

**Timing:** 4th period

**Learning outcomes:** Upon completion of the course, student will be able to - analyze continuous and categorical response in the most common experimental and observational studies - critically evaluate scientific articles - implement and interpret analyses of a statistical software concerning issues of the course.

**Contents:** - Skills for performing statistical analyses and inferences on the basis of data obtained in common experimental and observational studies are expanded and deepened - statistical literacy of scientific articles with quantitative methods

**Mode of delivery:** Face-to-face teaching

**Learning activities and teaching methods:** Total 50 h face-to-face teaching including lectures and exercise (partly computer exercises). Independent work 83 h.

**Target group:** Minor students

**Prerequisites and co-requisites:** The recommended prerequisite prior to enrolling for the course is the completion of the course: 806118P Introduction to Statistics or 806116P Statistics for Economic Sciences.

**Recommended optional programme components:** After the course, student is able to continue other statistics courses.

**Recommended or required reading:** Lecture notes

**Assessment methods and criteria:** Mid-term exams and/or final exam and possible homework.

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

**Person responsible:** Jari Päckilä

**Working life cooperation:** No

**Other information:** -

### 901050Y Toinen kotimainen kieli (ruotsi), kirjallinen kielitaito (BMTK) (1cp)

Second Official Language (Swedish), Written Skills

**Taitotaso:** B1/B2/C1 (Eurooppalainen viitekehys)

**Asema:** Pakollinen opintojakso. Opintojakso on tarkoitettu niille opiskelijoille, jotka ovat saaneet koulusivistyksensä suomen kielellä. Kielitaito vastaa kaksikielisellä virka-alueella toimivalta korkeakoulututkinnon suorittaneelta valtion virkamieheltä vaadittavaa kielitaitoa (Laki 424/03 ja asetus 481/03). Kurssi sisältää myös opintojakson 901051Y, suullinen kielitaito, Biokemian ja molekyyliiläketieteen tdk, 2 op.

**Lähtötasovaatimus:** Riittävä lähtötaso on lukion päästötodistuksen arvosana 7 tai yo-arvosana A-L TAI IB-koulun Swedish B SL vähintään arvosanalla 3 JA hyväksytysti suoritettu lähtötasotesti varsinaisen kurssin alussa. Lähtötasotestin perusteella opiskelija ohjataan tarvittaessa täydentämään taitojaan itseohjatuun opiskelun (901028Y Pääväg 1-3 op) avulla, sillä peruskieliopin ja -sanaston hallinta on edellytyksenä työelämän eri viestintätilanteissa tarvittavan kielitaidon saavuttamiseksi. Katso kohta [Lähtötasovaatimus](#). Mikäli opiskelijalla ei ole riittävää lähtötasoa, riittävät perustaidot tulee hankkia jo ENNEN tutkinnossa vaadittavaa pääaine kohtaista pakollista kurssia. Tiedot täydennystavoista löytyvät Kieli- ja viestintäkoulutuksen verkkosivuilta [www.oulu.fi/kielikoulutus](http://www.oulu.fi/kielikoulutus) > Opiskelu > Opinnot > Opinto-opas > Ruotsi > Ruotsin lähtötaso.

**Opetuskieli:** Ruotsi

**Ajoitus:** 3. lukuvuoden syyslukukausi

**Osaamistavoitteet:** Opiskelija saavuttaa sellaisen ruotsin kielen taidon, jota tarvitaan oman alan työtehtävissä. Kurssin suoritettuaan opiskelija osaa toimia työelämän tyypillisissä viestintätilanteissa vuorovaikutteisesti. Opiskelija ymmärtää oman alansa puhuttua kieltä, osaa puhua ruotsia työelämän eri tilanteissa, pystyy lukemaan oman alansa tekstejä sekä kirjoittamaan työtehtäviinsä liittyviä tekstejä. Hänellä on valmius kehittää omaa kielitaitoaan autenttisissa kielenkäyttötilanteissa.

**Sisältö:** Viestinnällisiä suullisia ja kirjallisia harjoituksia, joiden tarkoituksena on kehittää ja syventää opiskelijan työelämässä tarvitsemää oman alan ruotsin kielen taitoa. Erityishuomio kohdistuu akateemisen ja oman alan käsitteistön ja terminologian hallintaan. Esiintymistaidon harjoittelua. Suullisen kielenkäytön tilannepohjaisia yksilö-, pari- ja ryhmäharjoituksia sekä pienryhmäkeskusteluita. Kuuntelutehtäviä, ajankohtaisia oman alan tekstejä, omaan alaan liittyviä kirjoitustehtäviä ja Optimatehtäviä.

**Järjestämistapa:** Lähiopetus

**Toteutustavat:** 36 oppituntia lähiopetusta ja Optimatyöskentelyä (2 x 90 min./viikko) ja niihin liittyvät valmistavat harjoitukset, itseohjattu opiskelu.

**Kohderyhmä:** Biokemian opiskelijat

**Esitietovaatimukset:** Ks. Lähtötaso

**Yhteydet muihin opintojaksoihin:** -

**Oppimateriaali:** Oppimateriaali on Optimassa. Kontaktitunneilla suositellaan käytettäväksi ensisijaisesti tablettia tai kannettavaa tietokonetta. Opiskelija voi halutessaan tulostaa materiaalin omakustanteisesti.

**Suoritustavat ja arviointikriteerit:** Kurssilla keskitytään sekä suullisen että kirjallisen kielitaidon parantamiseen, mikä edellyttää säännöllistä ja aktiivista osallistumista harjoituksiin sekä niihin valmistautumista. Kurssiin kuuluu suullisen arviointi ja kirjallisen kielitaidon testaus. Suullisen kielitaidon arvosana perustuu opiskelijan keskustelujen, esitelmien ja keskustelualustusten jatkuvaan arviointiin. Kirjallinen arvosana perustuu loppukokeeseen ja kurssin



aikana kirjoitettuihin raportteihin ym. tekstiharjoituksiin. **Vaihtoehtoiset suoritustavat:**

**Vaihtoehtoiset suoritustavat**

**Aiempien opintojen hyväksilukeminen**

**Ruotsin korvaaminen loppukokeella** Lue lisää [opintasuoritusten arvostelusta](#) yliopiston verkkosivulta.

**Arviointiasteikko:** Suullinen ja kirjallinen kielitaito testataan erikseen ja arvioidaan ns. KORU-suositusten mukaan (Korkeakoulujen ruotsin kielen taidon arviointi, HAMK-julkaisu 2006). Hyväksytystä suullisesta ja kirjallisesta kielitaidosta annetaan erilliset arvosanat: **tydyttävä tai hyvä** (ks. kieliasetus 481/2003). Arvosanat perustuvat jatkuvaan arviointiin ja testaukseen. Katso tarkemmin Kieli- ja viestintäkoulutuksen [www.sivuilla](http://www.sivuilla) [www oulu.fi/kielikoulutus](http://www oulu.fi/kielikoulutus) kohdasta opiskelu > opinnot > opinto-opas > ruotsi > arviointikriteerit.)

**Vastuuhenkilö:** Yliopisto-opettaja Hanna-Leena Ainonen  
**Työelämäyhteistyö:** -

**Lisätiedot:** Ilmoittaudutaan vain opintojaksolle **901050Y Ruotsin kieli, kirjallinen kielitaito, Biokemian ja molekyyliilääketieteen tdk 1 op.** Mikäli opiskelija on vapautettu ruotsin opinnoista jo peruskoulussa, tulee hänen hakea vastaava vapautus tiedekunnasta.

**901051Y Toinen kotimainen kieli (ruotsi), suullinen kielitaito (BMTK) (2cp)**

Second Official Language (Swedish), Oral Skills

**Asema:** ks. [901050Y](#) Toinen kotimainen kieli (ruotsi), kirjallinen kielitaito

**902100Y English for Biochemists 1 (3cp)**

English for Biochemists 1

**Proficiency level:** CEFR B2 - C1 for Reading, Speaking and Listening

**Status:** Compulsory for all 1st year biochemistry students unless you have received the grade "L" or "E" in the Finnish matriculation exam, in which case you can be exempted for some of the course.

**Required proficiency level:** English must have been the A1 or A2 language at school or equivalent English skills acquired otherwise.

**ECTS Credits:** The student workload is 80 hrs work/ 3 ECTS credits.

**Language of instruction:** English

**Timing:** 1st year autumn and spring term

- **Learning outcomes:** The aim of this course is to develop reading and listening comprehension skills and oral/aural fluency of participants, and their familiarity with discipline-specific vocabulary. By the end of the course students will: be familiar with various reading strategies for different purposes
- be able to apply personalised vocabulary-learning techniques
- demonstrate effective note-taking techniques and the ability to summarise when working with texts
- have demonstrated lecture listening and note-taking skills in field-related situations
- be able to present field-related subjects and use appropriate field-related vocabulary
- be able to defend a position in a debate
- have demonstrated the ability to participate in pair work communication and small group discussions.

**Contents:** Core skills practiced on this course are the following:

**EfB 1a:** reading in order to understand biochemistry texts, textbooks and research articles; applying different reading strategies to extract global or detailed information according to the reading purpose; understanding word formation in order to expand vocabulary, both general scientific and

field-specific; understanding basic grammatical structures of scientific English as well as text structure and cohesion markers for improved comprehension.

**EfB 1b:** practicing oral/aural skills relevant to studying at university level (lecture listening), taking part in the scientific community using professional vocabulary and demonstrating field-related knowledge (discussions, laboratory work, debating).

**Mode of delivery:** Contact teaching and on-line self-study elements

**Learning activities and teaching methods:** See Contents

**Target group:** 1st year Biochemistry students

**Prerequisites and co-requisites:** -

**Recommended optional programme components:** 902101Y English for Biochemists 2

**Recommended or required reading:** Course materials will be provided by the teacher in electronic form in Optima, for students to download and bring to class.

**Assessment methods and criteria:** Evaluation is based on assessment of active participation in class and the completion of end-term test and participating in small group tutoring for debate. Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:** Pass/fail

**Person responsible:** Eva Braidwood

**Working life cooperation:** -

**Other information:** -

**902154Y Scientific Communication for Biochemists (5cp)**

Scientific Communication for Biochemists

## M.Sc. Degree

### Advanced courses (biochemistry)

**740672S Kypsyysnäyte (FM-tutkinto) ()**

Maturity test (M.Sc. degree)

**ECTS Credits:** 0 credits

**Language of instruction:** Finnish / English

**Timing:** M.Sc. yr2

**Learning outcomes:** -

**Contents:** Will be written in context to Pro gradu thesis. In the test student must show a good command of both language skills and their field of Pro gradu thesis. If student's native language is not Finnish or Swedish Faculty of Science will define language in the test.

**Target group:** Majos students

**Prerequisites and co-requisites:** -

**Recommended optional programme components:** -

**Recommended or required reading:** -

**Assessment methods and criteria:** Written abstract of Pro Gradu thesis Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:** pass/fail

**Working life cooperation:** No

**Other information:** -

**743657S Tumor cell biology (3cp)**

Tumor cell biology

**ECTS Credits:** 3 credits

**Language of instruction:** English

**Timing:** M.Sc. yr1-yr2 spring

- **Learning outcomes:** Upon successful completion students are able to: name, list and



discuss the major aspects including formation of a tumor cell

- present, describe and discuss characteristic aspects of oncogenes and tumor suppressor genes
- use methods to study, examine and to analyse tumor genesis and tumor progression

**Contents:** The course covers basic aspects of the main pathways inducing formation of a tumor. The main emphasis will be made on the formation of oncogenes, the action of tumor suppressor genes and the induction of tumors by viruses.

**Mode of delivery:** Face to face teaching

**Learning activities and teaching methods:** 20 h lectures

**Target group:** MSc / Molecular and cellular biology

**Prerequisites and co-requisites:** -

**Recommended optional programme components:** -

**Recommended or required reading:** -

**Assessment methods and criteria:** Final exam Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:** 1-5/fail

**Person responsible:** Thomas Kietzmann

**Working life cooperation:** No

**Other information:** Location of instruction: Kontinkangas campus

### 743660S Introduction to immunology (3cp)

Introduction to immunology

**ECTS Credits:** 3 credits

**Language of instruction:** English

**Timing:** B.Sc. yr3 autumn or M.Sc. yr1-yr2 autumn

**Learning outcomes:** After the course students will be able to identify, analyze and apply essential cellular molecules, components and mechanisms related to immunology, and complete their previous knowledge of molecular and cellular biology and protein chemistry with immunobiochemistry issues.

**Contents:** The course handles both unspecific and specific immune response mechanisms, antibody structure and diversity, antibody-based immunodiagnostics, as well as basics of virus biochemistry.

**Mode of delivery:** Face to face teaching

**Learning activities and teaching methods:** Lectures (12 h), a written home exercise, and a final exam

**Target group:** MSc/ molecular and cellular biology

**Prerequisites and co-requisites:** Preliminary required courses: Molekyylibiologia I, Protein chemistry I and Solun biologia, or equivalent basic molecular biology, protein chemistry and cell biology studies.

**Recommended optional programme components:** -

**Recommended or required reading:** -

**Assessment methods and criteria:** Home exercise, final exam Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:** 1-5/fail

**Person responsible:** Valerio Izzì

**Working life cooperation:** No

**Other information:** This module is the same as 740379A Introduction to immunology. Location of instruction: Kontinkangas

### 743661S Virology (3cp)

Virology

**ECTS Credits:** 3 credits

**Language of instruction:** English

**Timing:** M.Sc. yr1-2 spring (starts 2015)

- **Learning outcomes:** 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:** 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 and 10h seminars where the students should be able to recapitulate major aspects of the taught material in 5-7 min presentations.

**Mode of delivery:** Face to face teaching

**Learning activities and teaching methods:** 24 h lectures and student presentations in seminars

**Target group:** MSc / Molecular and cellular biology

**Prerequisites and co-requisites:** Cellular biology

**Recommended optional programme components:** -

**Recommended or required reading:** -

**Assessment methods and criteria:** Final exam Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:** 1-5/fail

**Person responsible:** Thomas Kietzmann

**Working life cooperation:** No

**Other information:** This module is the same as Virology (740380A). Location of instruction: Kontinkangas

### 743662S Extracellular matrix (5cp)

Extracellular matrix

**ECTS Credits:** 5 credits

**Language of instruction:** English

**Timing:** MSc yr1-2 spring

- **Learning outcomes:** Upon successful completion students are able to: Describe the structure and key components of the mammalian 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 common other 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 postgraduate research project in the ECM field

**Contents:** 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 in 2016: Collagens and collagen-related hereditary diseases; Proteoglycans and glycoproteins; Basement membranes; Pericellular matrix of the vasculature; Integrins and other ECM receptors; Matricellular proteins; Elastic fibres; ECM plasticity and remodeling; ECM degrading enzymes; Stem cell microenvironments; ECM in fibrosis and cancer. The course has limited enrollment for 28 students.

**Mode of delivery:** Face to face teaching

**Learning activities and teaching methods:** 23 h lectures, 6 h seminars, and 36 h laboratory work. Seminars and laboratory work are compulsory

**Target group:** MSc / Molecular and cellular biology

**Prerequisites and co-requisites:** -

**Recommended optional programme components:** -

**Recommended or required reading:** **Extracellular Matrix Biology** Eds. Richard O. Hynes and Kenneth M. Yamada, 2011. Cold Spring Harbor Perspectives in Biology [http://cshperspectives.cshlp.org/site/misc/extracellular\\_matrix\\_biology.xhtml](http://cshperspectives.cshlp.org/site/misc/extracellular_matrix_biology.xhtml)

**Assessment methods and criteria:** Continuous assessment, final exam

**Grading:** 1-5/fail

**Person responsible:** Ritva Heljasvaara

**Working life cooperation:** No

**Other information:** Location of instruction: Kontinkangas

### **743663S Developmental biology, stem cells and tissue engineering (5cp)**

Developmental biology, stem cells and tissue engineering

**ECTS Credits:** 5 credits

**Language of instruction:** English

**Timing:** MSc yr1-2 spring

**Learning outcomes:** 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:** 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.

**Mode of delivery:** Face to face teaching

**Learning activities and teaching methods:** 32 h lectures, 3 assessments and 25 h laboratory work. Lectures (80% attendance), assessments and laboratory work are compulsory.

**Target group:** MSc / Molecular and cellular biology

**Prerequisites and co-requisites:** -

**Recommended optional programme components:** -

**Recommended or required reading:** -

**Assessment methods and criteria:** Continuous assessment, no exam

**Grading:** 1-5/fail

**Person responsible:** Seppo Vainio and Aleksandra Rak-Raszewska

**Working life cooperation:** No

**Other information:** Location of instruction: Kontinkangas

### **743664S Hypoxia response pathway - molecular mechanisms and medical applications (5cp)**

Hypoxia response pathway - molecular mechanisms and medical applications

**ECTS Credits:** 5 credits

**Language of instruction:** English

**Timing:** MSc yr1-2 autumn

- **Learning outcomes:** 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:** 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.

**Mode of delivery:** Face to face teaching

**Learning activities and teaching methods:** 28 h lectures, 21 h seminars (obligatory) and 4 h round table discussions.

**Target group:** MSc / Molecular and cellular biology

**Prerequisites and co-requisites:** -

**Recommended optional programme components:** -

**Recommended or required reading:** Lecture notes, student seminar presentations, research articles.

**Assessment methods and criteria:** 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.

**Grading:** 1-5/fail

**Person responsible:** Peppi Karppinen

**Working life cooperation:** No

**Other information:** Location of instruction: Kontinkangas

### **743665S Molecular, cell biological and genetic aspects of diseases (5cp)**

Molecular, cell biological and genetic aspects of diseases

**ECTS Credits:** 5 credits

**Language of instruction:** English

**Timing:** MSc yr1-2 autumn

- **Learning outcomes:** 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
- present and defend a scientific presentation on a theme related to inherited diseases.

**Contents:** The course provides knowledge on structure and function of mitochondria, peroxisomes, endoplasmic reticulum (ER) and the Golgi apparatus, and diseases - also inherited ones - concerned with these cell organelles; as well as gene defects, their inheritance, detection and correction with gene therapy. The course involves student presentations of latest findings on inherited diseases as pair work.

**Mode of delivery:** Face to face teaching

**Learning activities and teaching methods:** 26 h lectures and seminars including student presentation and student opponents. Seminars are obligatory.

**Target group:** MSc / Molecular and cellular biology

**Prerequisites and co-requisites:** B.Sc. in biochemistry or biology or otherwise adequate knowledge on basic biochemistry and cellular and molecular biology.

**Recommended optional programme components:** -

**Recommended or required reading:** Lecture notes, student seminar presentations, research articles. Recommended accompanying texts: Thompson & Thompson, Genetics in Medicine; Strachan, T., Read, A.P.: Human Molecular Genetics, Bios. Scientific Publishers Limited; Aula et al., Perinnöllisyyslääketiede

**Assessment methods and criteria:** 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.

**Grading:** 1-5/fail

**Person responsible:** Heli Ruotsalainen

**Working life cooperation:** no

**Other information:** Location of instruction: Kontinkangas

### **743697S Molekyylilääketieteen erikoistyö (28cp)**

Pro gradu experimental work in molecular medicine

**ECTS Credits:** 28 credits

**Timing:** MSc yr1-2

- **Learning outcomes:** On successful completion of this course, the student has increased appreciation of how research leads to knowledge and how technologies may be applied/adapted to address a research question
- Developed abilities to work independently and as part of a team - self motivation, diplomacy, planning and organizational skills and time management.
- Developed abilities to identify and solve practical problems, to design and execute experiments and how to record and critically evaluate data.

**Contents:** This module provides an extensive, 6 month, project in a research group. The experimental work can be started after 30 op of Master studies have been completed. Students are responsible for finding a suitable research group in which they wish to undertake the Pro Gradu work. Students should produce a short (typically 2 page) study plan detailing the proposed content of their Pro Gradu work, supervisor(s) and start date which must be approved before they start work. The Pro Gradu thesis is based only on the work done during the first 6 months of work by the student on the project, except in cases of mitigating circumstances. The work may be undertaken in the research groups of Faculty of Biochemistry and Molecular Medicine or in any other suitable research group in Finland or abroad.

**Mode of delivery:** Face to face teaching

**Learning activities and teaching methods:** 6 months project in a research group

**Target group:** MSc/ Molecular medicine

**Prerequisites and co-requisites:** -

**Recommended optional programme components:** -

**Recommended or required reading:** -

**Assessment methods and criteria:** Research work 6 months

**Grading:** Pass/fail

**Person responsible:** Lloyd Ruddock

**Working life cooperation:** Yes

**Other information:** -

### 743698S Molekyylilääketieteen pro gradu -tutkielma (20cp)

Pro gradu thesis in molecular medicine

**ECTS Credits:** 20 credits

**Timing:** MSc yr2

- **Learning outcomes:** On successful completion of this course, the student has developed skills in retrieving, appraising critically and integrating information.
- Developed skills in communicating science and in making and defending scientific arguments.

**Contents:** The Pro gradu thesis (typically around 50-60 pages long) is based on the experimental work undertaken by the student and the contextualization of the research and the results based on the published literature in the field. For detailed instructions see <http://www oulu.fi/fbmm>

**Mode of delivery:** Face to face teaching

**Target group:** MSc/Molecular medicine

**Prerequisites and co-requisites:** -

**Recommended optional programme components:** -

**Recommended or required reading:** -

**Assessment methods and criteria:** Written thesis

**Grading:** 1-5/fail

**Person responsible:** Tuomo Glumoff

**Working life cooperation:** No

**Other information:** -

### 743699S Final examination in molecular medicine (9cp)

Final examination in molecular medicine

**ECTS Credits:** 9 credits

**Language of instruction:** English

**Timing:** MSc yr1-yr2

- **Learning outcomes:** Upon successful completion students (should) be able to: discuss the full breadth of the core topics of biochemistry and molecular medicine
- Integrate material from multiple sources

**Contents:** This examination will test the ability of students to integrate knowledge from BSc and MSc level molecular medicine. The questions will require an understanding of the principles of biochemistry and molecular medicine and will be based on subject specific material from relevant BSc and MSc level modules. The format will be an oral examination.

**Mode of delivery:** Face to face teaching

**Learning activities and teaching methods:** Student self-study

**Target group:** MSc/ molecular medicine

**Prerequisites and co-requisites:** -

**Recommended optional programme components:** -

**Recommended or required reading:** -

**Assessment methods and criteria:** Oral examination

**Grading:** 1-5/fail

**Person responsible:** Thomas Kietzmann

**Working life cooperation:** No

**Other information:** Location of instruction: Kontinkangas

### 744617S Orientation to research work (0-20cp)

Orientation to research work

**ECTS Credits:** 12 - 20 credits (see Other information)

**Language of instruction:** English

**Timing:** MSc yr 1

- **Learning outcomes:** 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:** 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 1.5op being awarded for each full-time week equivalent worked. A maximum of 6op can be awarded for working 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.

**Mode of delivery:** Face to face teaching

**Learning activities and teaching methods:** Independent work

**Target group:** Major students

**Prerequisites and co-requisites:** -

**Recommended optional programme components:** -

**Recommended or required reading:** -

**Assessment methods and criteria:** Research work Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:** pass/fail

**Person responsible:** Jari Heikkinen

**Working life cooperation:** Yes

**Other information:** The sum of credits from courses 744624S and 744617S must be 12-20 credits (for Int MSc in protein science line 12-18 credits)

### 744618S Dissertation (18cp)

Dissertation

**ECTS Credits:** 18 credits

**Language of instruction:** English

**Timing:** M.Sc. yr1-yr2

- **Learning outcomes:** Upon successful completion students are able to: apply

information in the right context, integrate information from a wide range of sources and evaluate it critically

- communicate science in extensive written format and discuss and defend scientific arguments
- demonstrate independent work including self motivation, planning, organizational skills and time management.

**Contents:** This module is based around the student producing an extensive, in-depth literature report in the style of a scientific review. Students are responsible for finding a suitable supervisor for their dissertation with whom they will discuss the scientific background and relevant literature. Students are strongly encouraged to meet with their supervisor weekly to discuss progress and ideas and to resolve problems. A one-page outline of the dissertation subject area, including details of the supervisor (who need not be from the University of Oulu), must be approved by the module convener before starting this module. While the dissertation subject can be closely linked with the Pro Gradu project subject, students are advised that having distinct topics for these two modules will look better on their CV.

**Mode of delivery:** Face to face teaching

**Learning activities and teaching methods:** 480 hours of student work

**Target group:** Major students

**Prerequisites and co-requisites:** -

**Recommended optional programme components:** -

**Recommended or required reading:** -

**Assessment methods and criteria:** Written report Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:** 1-5/fail

**Person responsible:** Lloyd Ruddock

**Working life cooperation:** No

**Other information:** -

#### 744619S Systems biology (4cp)

Systems biology

**ECTS Credits:** 4 credits

**Language of instruction:** English

**Timing:** M.Sc. 1st-2nd autumn

**Learning outcomes:** After the course student is able to define the cell as an ensemble of structural and functional parts. He is also able to connect and describe their current knowledge on cellular, molecular and structural biology into a general view. The student is also able to assess scientific information critically on novel research findings and the problems associated with massive amounts of novel scientific information.

**Contents:** The module aims to give a holistic picture of the cell as a system. Cells contain numerous molecules and complex structures that interact with each other to form complex interaction networks such that when taken together they form a new whole, which cannot be understood by just investigating the parts. Methods to collect and assemble biological/biochemical information for systems analysis will be introduced. Possibilities of systems approach will be critically discussed in relation to available research techniques, techniques of the future, applications, research targets, as well as from the philosophical and ethical point of view including applicability of the systems theory in biosciences.

**Mode of delivery:** Face to face teaching

**Learning activities and teaching methods:** The module consists of 22 h of lectures, discussions and case studies, ca. 5h of computing exercises

**Target group:** Major students

**Prerequisites and co-requisites:** B.Sc. in biochemistry or a related subject or otherwise adequate knowledge on cellular, molecular and structural biology.

**Recommended optional programme components:** -

**Recommended or required reading:** -

**Assessment methods and criteria:** Study diaries will be assessed for a mark on scale 1 to 5 upon request. Otherwise marking will be Pass/fail. There is no exam and thus presence on certain amount of the course is compulsory. Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:** 1-5/fail

**Person responsible:** Gonghong Wei

**Working life cooperation:** No

**Other information:** Location of instruction: Kontinkangas campus

#### 744620S Protein chemistry II (3cp)

Protein chemistry II

**ECTS Credits:** 3 credits

**Language of instruction:** English

**Timing:** M.Sc. yr1 autumn

- **Learning outcomes:** After the course, the students are able to: describe professional literature dealing with advanced techniques of protein analysis
- plan and implement the purification of a given protein on a large scale
- present and explain work related to protein purification and analysis

**Contents:** This module provides a “real-life” approach to practical protein chemistry, including purification, biophysical analysis, enzymatics, etc. It comprises a small number of revision lectures, but it is primarily based on problem solving based exercises with a further level of complexity built in compared with Protein Chemistry I. The module includes a student presentation, but does not include a final examination. The final mark comprises marks from continuous assessment. Attendance of some parts of the course is compulsory.

**Mode of delivery:** Face to face teaching

**Learning activities and teaching methods:** 12 h seminars, plus exercises and a student report

**Target group:** Major students

**Prerequisites and co-requisites:** -

**Recommended optional programme components:** -

**Recommended or required reading:** -

**Assessment methods and criteria:** Continuous assessment, presentation Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:** Pass/fail

**Person responsible:** Lari Lehtio ja Teemu Haikarainen

**Working life cooperation:** No

**Other information:** Location of instruction: Kontinkangas campus

#### 744621S Molecular biology II (3cp)

Molecular biology II

**ECTS Credits:** 3 credits

**Language of instruction:** English

**Timing:** M.Sc. yr1 autumn

- **Learning outcomes:** After the course students are able to: discuss the general features of DNA manipulating/amplifying enzymes
- design (on paper or in silico) oligonucleotides for PCR amplification, set up restriction digests and ligation reactions in order to carry out basic and advanced cloning procedures
- use basic tools used in the genetic manipulation of mice

**Contents:** 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, but it is primarily based on complex problem solving based exercises including written reports and group student presentations, but does not include a final



examination. The final mark comprises marks from continuous assessment. Attendance of the course is required.

**Mode of delivery:** Face to face teaching

**Learning activities and teaching methods:** 12 h seminars, plus student presentations

**Target group:** Major students

**Prerequisites and co-requisites:** The course is designed for students familiar with DNA organization, gene structure & genetic concepts (ORF, codon, heterologous and homologous recombination).

**Recommended optional programme components:** -

**Recommended or required reading:** -

**Assessment methods and criteria:** Written report, student presentation Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:** pass/fail

**Person responsible:** Elitsa Dimova

**Working life cooperation:** No

**Other information:** Location of instruction: Kontinkangas

### 744623S Yeast genetics (6cp)

Yeast genetics

**ECTS Credits:** 3-6 credits

**Language of instruction:** English

**Timing:** M.Sc. yr1-yr2 spring

- **Learning outcomes:** 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:** 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. The lecture part is open to all students that fulfill the enrollment requirements, and equals 3 op. 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 two weeks (2 days – 3 days – 2 days – 3 days) 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). This part of the course has limited enrollment for 16 people.

**Mode of delivery:** Face to face teaching

**Learning activities and teaching methods:** 16 h lectures, 10 days practical, final exam and oral participation in course review session

**Target group:** Major students

**Prerequisites and co-requisites:** -

**Recommended optional programme components:** -

**Recommended or required reading:** -

**Assessment methods and criteria:** Course review sessions, final exam, experiment reports Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:** 1-5/fail

**Person responsible:** Alexander Kastaniotis

**Working life cooperation:** No

**Other information:** Location of instruction: Kontinkangas campus

### 744624S Orientation to biochemical work (0-20cp)

Orientation to biochemical work

**ECTS Credits:** 12-20 credits (see Other information)

**Language of instruction:** English/Finnish

**Timing:** M.Sc. yr1

- **Learning outcomes:** 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:** 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 1.5op being awarded for each full-time week equivalent worked. A maximum of 6op can be awarded for working in one work placements. Each placement must be agreed in advance with the responsible person.

**Mode of delivery:** Face to face teaching

**Learning activities and teaching methods:** Independent work

**Target group:** Major students

**Prerequisites and co-requisites:** -

**Recommended optional programme components:** -

**Recommended or required reading:** -

**Assessment methods and criteria:** non-research work Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:** Pass/fail

**Person responsible:** Jari Heikkinen

**Working life cooperation:** Yes

**Other information:** The sum of credits from courses 744624S and 744617S must be 12-20 credits (for Int MSc in protein science line 12-18 credits)

### 744625S Tieteellinen kokousesitelmä (1-2cp)

Scientific presentation

**ECTS Credits:** 1-2 credits

**Language of instruction:** Finnish and English

**Timing:** M.Sc.

**Learning outcomes:** The student makes a presentation and participates in an international scientific conference with their own presentation. The presentation may be a poster, a talk or equivalent. The student uses the skills learned in the B.Sc. or otherwise in planning and realizing the presentation. The student practices communication skills necessary for research work.

**Contents:** Student participates in a conference and delivers a poster, a talk or equivalent. The contents of which must include student's own results, for example from the Master's Thesis work. The pro gradu supervisor or other suitable person supervises the planning and realization of the presentation.

**Mode of delivery:** Face to face teaching

**Learning activities and teaching methods:** A poster, a talk or equivalent is delivered. The workload of the course may vary depending on the extent and the form of presentation.

**Target group:** Major students (MSc)

**Prerequisites and co-requisites:** No compulsory preceding courses

**Recommended optional programme components:** -

**Recommended or required reading:** -

**Assessment methods and criteria:** Study diary, a copy of presentation or poster Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:** pass/fail

**Person responsible:** Jari Heikkinen

**Working life cooperation:** No

**Other information:** The amount of credits is estimated

based on the workload of the planning and realization of the presentation, but not the length of the meeting.

### 747601S Protein production and analysis (8cp)

Protein production and analysis

**ECTS Credits:** 8 credits

**Language of instruction:** English

**Timing:** Int M.Sc. yr1 autumn

- **Learning outcomes:** 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:** 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, basic proteomics and mass spectrometry. This course covers some of the material taught in Protein Chemistry I (740364A) and Molekyylibiologia I (740361A) and therefore cannot be taken by students who have either of these modules.

**Mode of delivery:** Face to face teaching

**Learning activities and teaching methods:** 46 contact hours of lectures and seminars, 80 hours of lab

**Target group:** Int MSc in Prot Sci

**Prerequisites and co-requisites:** A BSc in biochemistry or a closely related subject.

**Recommended optional programme components:** -

**Recommended or required reading:** -

**Assessment methods and criteria:** Continuous assessment (problem solving exercises, lab reports) Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:** 1-5/fail

**Person responsible:** Lloyd Ruddock

**Working life cooperation:** No

**Other information:** Location of instruction: Kontinkangas campus

### 747606S Structural enzymology (3cp)

Structural enzymology

**ECTS Credits:** 3 credits

**Language of instruction:** English

**Timing:** M.Sc. yr1-yr2 spring

- **Learning outcomes:** Upon successful completion students are able to: discuss the methods that are used to crystallize proteins
- describe the basic concepts of the transition state theory
- define the relation between reaction rates and free energy barriers
- describe enzyme reaction mechanisms
- describe the concepts of catalytic bases and acids
- illustrate active site strain
- tell the importance of active site electrostatics
- describe the concept of transition state analogues

**Contents:** General and specific aspects of the reaction mechanism of several well studied enzymes will be discussed. It will include the serine proteases (such as chymotrypsin and trypsin). The following topics will be addressed: Chemical catalysis, transition state theory,

forces stabilizing the enzyme-ligand interaction, structural properties of proteins, enzyme kinetics, crystallization of proteins, general aspects of enzyme catalysed reactions, reaction mechanisms of serine proteases, transition state analogues. The course is aimed at biochemistry and chemistry students.

**Mode of delivery:** Face to face teaching

**Learning activities and teaching methods:** 20 h lectures and seminars

**Target group:** M.Sc. in Protein science and biotechnology

**Prerequisites and co-requisites:** -

**Recommended optional programme components:** -

**Recommended or required reading:** -

**Assessment methods and criteria:** Oral presentation  
Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:** pass/fail

**Person responsible:** Rikkert Wierenga

**Working life cooperation:** No

**Other information:** Location of instruction: Kontinkangas campus

### 747608S Biochemical methodologies II (8cp)

Biochemical methodologies II

**ECTS Credits:** 8 credits

**Language of instruction:** English

**Timing:** MSc 1st autumn

- **Learning outcomes:** Upon successful completion students are able to: describe the theoretical basis of the main biochemical analysis methods for proteins
- identify and 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

**Contents:** 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 fluorescence spectroscopy, stopped flow analysis of enzymatic reactions, circular dichroism, surface plasmon resonance, micro-calorimetry, mass spectrometry, and proteomics based on 2D electrophoresis. For assessment each student has to write a research report in the style of a scientific publication. Attendance is compulsory.

**Mode of delivery:** Face to face teaching

**Learning activities and teaching methods:** 120 h lab., including pre-lab lectures plus exercises

**Target group:** Obligatory for M.Sc. in Protein Science and biotechnology

**Prerequisites and co-requisites:** Protein production and analysis (747601S) or Protein chemistry I (740364A)

**Recommended optional programme components:** -

**Recommended or required reading:** -

**Assessment methods and criteria:** Report written in style of a scientific publication  
Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:** 1-5/fail

**Person responsible:** Ulrich Bergmann

**Working life cooperation:** No

**Other information:** Location of instruction: Kontinkangas campus

### 747611S Biochemistry of protein folding (3cp)

Biochemistry of protein folding

**ECTS Credits:** 3 credits

**Language of instruction:** English

**Timing:** M.Sc., yr1-yr2 spring

- **Learning outcomes:** 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 contextualise this data and to solve problems relating to interpretation.

**Contents:** This module provides an introduction to protein folding in vivo. 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.

**Mode of delivery:** Face to face teaching

**Learning activities and teaching methods:** 16 contact hours of lectures and seminars

**Target group:** M.Sc. in Protein science and biotechnology

**Prerequisites and co-requisites:** Protein chemistry I (740364A) or Protein production and analysis (747601S) or equivalent

**Recommended optional programme components: -**

**Recommended or required reading: -**

**Assessment methods and criteria:** The module is assessed based on a report prepared on individual topics and on participation in the seminars. Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:** 1-5/fail

**Person responsible:** Lloyd Ruddock

**Working life cooperation:** No

**Other information:** Location of instruction: Kontinkangas

### 747613S In silico methodologies in biochemistry and molecular medicine (5cp)

In silico methodologies in biochemistry and molecular medicine

**ECTS Credits:** 5 credits

**Language of instruction:** English

**Timing:** MSc yr1-2 autumn

- **Learning outcomes:** After a successful completion of this course, students will have obtained an appreciation of the quantitative aspects of analyzing scientific (big) data either stored in large data databases or generated by sophisticated modeling and simulation tools.
- Gained a basic understanding of applying various bioinformatics methods to large biological data sets.
- Realized the potential of scientific computing for the study of the behavior of biological systems, in particular large biological macromolecules.

**Contents:** This course aims at emphasizing the quantitative aspects of scientific research. For this, the course contains three intertwined components: (i) searching and evaluating nucleic acid and protein structural data from various databases, (ii) use of scientific computing to study structural, dynamical, functional and thermodynamical properties of proteins and membranes and their interaction with other molecules, and (iii) using biocomputing tools to access and analyze large and high-throughput data produced and accessible through biochemical and computational experiments. 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 genome-wide mapping of protein-DNA interaction, proteomics-based bioinformatics, and high-throughput mapping of protein-protein interaction networks. Commonly employed modeling and simulation techniques will also be dealt with. These include molecular dynamics, Monte Carlo and Langevin (stochastic, Brownian) dynamics, continuum electrostatics, statistical thermodynamics, protein modeling techniques, protein-ligand docking, protein-ligand affinity calculations and the computer simulation of the protein folding process and enzyme action.

**Mode of delivery:** Face to face teaching

**Learning activities and teaching methods:** 74 h contact sessions. Lectures and practicals, student tasks, including the presentation of an original article. Attendance to practicals and article presentation are mandatory.

**Target group:** MSc / Protein science and biotechnology

**Prerequisites and co-requisites: -**

**Recommended optional programme components: -**

**Recommended or required reading:** Books, articles: 1. Big data in biomedicine (<http://www.nature.com/nature/outlook/big-data/>) 2. Holzinger, A. Biomedical informatics, Springer, Heidelberg, 2014. 3. PubMed (Publications) (<http://www.ncbi.nlm.nih.gov/pubmed/>) 4. Leach, A.R., Molecular modelling. Principles and applications, Second edition, Prentice Hall, New York, 2001 5. Berendsen, H.J.C Simulating the physical world. Hierarchical modeling from quantum mechanics to fluid dynamics., Cambridge University Press, Cambridge, 2007 Useful databases: 1. GenBank (DNA) (<http://www.ncbi.nlm.nih.gov/nucleotide>) 2. Ensembl and Ensembl Genomes (Genome) (<http://www.ensembl.org/> and <http://ensemblgenomes.org/>) 3. UniProt (Protein) (<http://www.uniprot.org/>) 4. DIP and BioGrid (Protein Interaction) (<http://dip.doe-mbi.ucla.edu/dip/Main.cgi> and <http://thebiogrid.org/>) 5. PDB (protein structure database) (<http://www.rcsb.org/>) 6. Entrez (<http://www.ncbi.nlm.nih.gov/gquery/gquery.fcgi>)

**Assessment methods and criteria:** Practical evaluation, article presentation, group discussion, and project report. No exam.

**Grading:** pass/fail

**Person responsible:** André H. Juffer

**Working life cooperation:** no

**Other information:** Location of instruction: Kontinkangas campus

### 747614S Macromolecular X-ray crystallography (5cp)

Macromolecular X-ray crystallography

**ECTS Credits:** 5 credits

**Language of instruction:** English

**Timing:** MSc yr1-2 spring

- **Learning outcomes:** 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:** 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.

**Mode of delivery:** Face to face teaching

**Learning activities and teaching methods:** 35 h lectures, 52 h exercises, project work and a research report

**Target group:** MSc / Protein science and biotechnology

**Prerequisites and co-requisites:** Protein chemistry I or protein production and analysis or equivalent

**Recommended optional programme components:** -

**Recommended or required reading:** Rupp, B: Biomolecular Crystallography: Principles, Practice and Application to Structural Biology Blow, D: Outline of Crystallography for Biologists (eBook available) Drenth, J: Principles of Protein X-Ray Crystallography

**Assessment methods and criteria:** Continuous assessment, research report, no exam.

**Grading:** pass/fail

**Person responsible:** Lari Lehtiö and Rikkert Wierenga

**Working life cooperation:** no

**Other information:** Location of instruction: Kontinkangas campus

### 747615S Introduction to structure-based drug discovery (5cp)

Introduction to structure-based drug discovery

**ECTS Credits:** 5 credits

**Language of instruction:** English

**Timing:** MSc yr1-2 spring

- **Learning outcomes:** 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:** 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 24 students.

**Mode of delivery:** Face to face and web based teaching

**Learning activities and teaching methods:** 12 h Lectures, 48 h practicals and group work, 9 h student presentations and discussions

**Target group:** MSc / Protein science and biotechnology

**Prerequisites and co-requisites:** BSc in biochemistry or a related subject, Protein Chemistry I or Protein production and analysis

**Recommended optional programme components:** -

**Recommended or required reading:** -

**Assessment methods and criteria:** Continuous assessment, presentations, oral exam

**Grading:** 1-5/fail

**Person responsible:** Lari Lehtiö

**Working life cooperation:** no

**Other information:** Location of instruction: Kontinkangas campus

### 747691S Pro gradu experimental work in protein science

### and biotechnology (28cp)

Pro gradu experimental work in protein science and biotechnology

**ECTS Credits:** 28 credits

**Language of instruction:** English

**Timing:** M.Sc. yr1-yr2

- **Learning outcomes:** After the experimental work students is able to: undertake scientific research with supervision using typical methods in biochemistry
- plan and perform experiments in laboratory, perform efficient time management, consider his motivation and how to improve that, work independently and as part of a team
- identify and solve practical problems, record and critically evaluate data

**Contents:** This module provides an extensive, 6 month, project in a research group. The experimental work can be started after 30 op of Master studies have been completed. Students are responsible for finding a suitable research group in which they wish to undertake the Pro Gradu work. Students should produce a short (typically 2 page) study plan detailing the proposed content of their Pro Gradu work, supervisor(s) and start date which must be approved before they start work. The Pro Gradu thesis is based only on the work done during the first 6 months of work by the student on the project, except in cases of mitigating circumstances. The work may be undertaken in the research groups of Faculty of Biochemistry and Molecular Medicine or in any other suitable research group in Finland or abroad.

**Mode of delivery:** Face to face teaching

**Learning activities and teaching methods:** Independent work

**Target group:** M.Sc. in Protein science and biotechnology

**Prerequisites and co-requisites:** -

**Recommended optional programme components:** -

**Recommended or required reading:** -

**Assessment methods and criteria:** Laboratory work of six months Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:** pass/fail

**Person responsible:** Lloyd Ruddock

**Working life cooperation:** Yes

**Other information:** -

### 747692S Pro gradu thesis in protein science and biotechnology (20cp)

Pro gradu thesis in protein science and biotechnology

**ECTS Credits:** 20 credits

**Language of instruction:** English

**Timing:** M.Sc. yr2

- **Learning outcomes:** On successful completion of this course, the student is able to: retrieve and appraise information critically and integrate information to new entity
- communicate in science and make and defend scientific arguments.

**Contents:** The Pro gradu thesis (typically around 50-60 pages long) is based on the experimental work undertaken by the student and the contextualization of the research and the results based on the published literature in the field. For detailed instructions see <http://www oulu.fi/fbmm>.

**Mode of delivery:** Face to face teaching

**Learning activities and teaching methods:** -

**Target group:** M.Sc. in Protein science and biotechnology

**Prerequisites and co-requisites:** -

**Recommended optional programme components:** -

**Recommended or required reading:** -

**Assessment methods and criteria:** Written thesis Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:** 1-5/fail



**Person responsible:** Tuomo Glumoff  
**Working life cooperation:** No  
**Other information:** -

### 747693S Final examination in protein science and biotechnology (9cp)

Final examination in protein science and biotechnology

**ECTS Credits:** 9 credits

**Language of instruction:** English

**Timing:** M.Sc. yr1-yr2

- **Learning outcomes:** Upon successful completion students should be able to: discuss the full breadth of the core topics of biochemistry, protein science and biotechnology
- Integrate material from multiple sources

**Contents:** This examination will test the ability of students to integrate knowledge from BSc and MSc level protein science and biotechnology. The questions will require an understanding of the principles of biochemistry and protein science and will be based on subject specific material from relevant BSc and MSc level modules. The format will be an oral examination.

**Mode of delivery:** Face to face teaching

**Learning activities and teaching methods:** Student self-study

**Target group:** M.Sc. in Protein science and biotechnology

**Prerequisites and co-requisites:** -

**Recommended optional programme components:** -

**Recommended or required reading:** -

**Assessment methods and criteria:** Oral examination Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:** 1-5/fail

**Person responsible:** Lloyd Ruddock

**Working life cooperation:** No

**Other information:** Location of instruction: Kontinkangas campus

production of proteins and metabolites.

**Contents:** Microbial homologous and heterologous protein production. Physiological and process related items in the production of selected microbial metabolites. Methods for process intensification. Scale-up of bioprocesses. Unit operations in product recovery and purification.

**Mode of delivery:** Blended teaching.

**Learning activities and teaching methods:** Lectures 36 h / homework 48 h / self-study 49 h.

**Target group:** Master students in bioprocess engineering. Master students in process engineering, environmental engineering and biochemistry with required prerequisites.

**Prerequisites and co-requisites:** Courses 488309A Biocatalysis, 488052A Introduction to Bioproduct and Bioprocess Engineering and 488304S Bioreactor technology, or respective knowledge.

**Recommended optional programme components:** -

**Recommended or required reading:** Will be announced at the lectures.

**Assessment methods and criteria:** Lectures, exercises and report. Grade will be composed of homework exercises and reports or final examination. Read more about the course assessment and grading systems of the University of Oulu at [www oulu.fi/english/studying/assessment](http://www oulu.fi/english/studying/assessment).

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

**Person responsible:** Dr. Sanna Taskila

**Working life cooperation:** No

**Other information:** -

### 488321S Bioreactor technology (5cp)

Bioreactor technology

**ECTS Credits:** 5 ECTS /133 hours of work

**Language of instruction:** English

**Timing:** The course is held in autumn semester during period 2. It is recommended to complete the course in the 4th (1st Master's) year.

**Learning outcomes:** After completing this course, the student will be able to verbally describe the most common equipment, materials and methods related to biotechnological processes, microbial growth and cultivation and sterilization. The student will be able to apply different mathematical formulas for biocatalysis and for the bioreactor performance and use those to plan and analyze bioprocesses. The student will also be able to produce, analyze and interpret data from bioprocesses.

**Contents:** Biotechnological process: General process schemes, batch, fed-batch and continuous processes, biocatalysts and raw materials. Reactor design and instrumentation. Sterilization: kinetics of heat inactivation and practical implementation of sterilization methods. Mathematical description and quantification of the function of biocatalysts. Monod and Michaelis-Menten models, reaction rates and their determination. The lag phase of growth, cellular maintenance, cell death. Kinetics of product and by-product formation. Kinetics of oxygen and heat transfer. Oxygen and heat balances: significance and calculations. Power consumption. Scale-up and scale-down.

**Mode of delivery:** Blended teaching.

**Learning activities and teaching methods:** Lectures 50 h / exercises 8 h / homework 16 h / self-study 59 h.

**Target group:** Master students in bioprocess engineering. Master students in process engineering, environmental engineering and biochemistry with required prerequisites.

**Prerequisites and co-requisites:** The previous bachelor level courses in Process or Environmental Engineering (especially 488309A Biocatalysis, 488052A Introduction to Bioproduct and Bioprocess Engineering) or respective knowledge.

**Recommended optional programme components:** -

**Recommended or required reading:** Lectures: Lecture hand outs; Doran, P. M. Bioprocess engineering principles. Academic Press. London, 2010. supplementary material:

## Courses from other Degree programmes

### 030008P Information Skills for foreign degree students (1cp)

Information Skills for foreign degree students

### 040911S Eläinten käyttäminen tutkimuksessa - kurssi toimenpiteiden suorittajalle (3cp)

Using animals in research - carrying out procedures

### 300002M Tiedonhankinta opinnäytetyössä (1cp)

Advanced Information Skills

### 488305S Advanced Course for Biotechnology (5cp)

Advanced Course for Biotechnology

**ECTS Credits:** 5 ECTS /133 hours of work

**Language of instruction:** English

**Timing:** The course is held in spring semester during period 3. It is recommended to complete the course in the 4th (1st Master's) year.

**Learning outcomes:** After completing this course, the student will be able to describe the most important techniques - both up- and downstream - in biotechnological

Villadsen J., Nielsen J., Liden G. Bioreactor engineering principles. Springer Verlag, 2011. Shuler ML., Kargi F. Bioprocess engineering basic concepts. 2nd ed. Pearson. 2002 and 2014.

**Assessment methods and criteria:** Lectures, exercises, final exam, homework. Grade will be composed of final exam, exercises and homework. Read more about the course assessment and grading systems of the University of Oulu at [www.oulu.fi/english/studying/assessment](http://www.oulu.fi/english/studying/assessment)

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

**Person responsible:** Dr Johanna Panula-Perälä

**Working life cooperation:** No

**Other information:** -

### **580402S Biomedical Imaging Methods (1-5cp)**

Biomedical Imaging Methods

**ECTS Credits:** 1-5 ECTS credit points / 27-135 hours of work.

**Language of instruction:** English

**Timing:** Master studies, 4th period. The course is not organized every year.

**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:** 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.

**Target group:** Master Students of Medical and Wellness technology and Biomedical Engineering and all other who are interested in methods of biomedical imaging

**Recommended or required reading:** Required literature is given in the lectures.

**Assessment methods and criteria:** Participation in the lectures and demonstrations, study diary. Exercises. Written exam. The course can be taken as 1, 2, 3 or 5 ECTS. 1 ECTS — participation in the lectures 2 ECTS — participation in the lectures and demonstrations 3 ECTS — participation in the lectures and demonstrations + practical assignment 5 ECTS — participation in the lectures and demonstrations + practical assignment and final exam

**Grading:** The 1, 2 or 3 ECTS courses utilize verbal grading: pass or fail. The 5 ECTS course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

**Person responsible:** Associate Professor Simo Saarakkala

**Working life cooperation:** No