Programme syllabus

Degree Programme in Biotechnology
Civilingenjörsutbildning i bioteknik

300.0 credits

Valid for students admitted to the education from autumn 15 (HT - Autumn term; VT - Spring term).

This is a translation of the Swedish, legally binding, programme syllabus.

Programme objectives

Knowledge and understanding

To receive a Degree of Master of Science in Engineering, Degree Programme in Biotechnology, the student should show:

- skills and understanding of fundamental, scientific and technical aspects of biotechnology
- advanced knowledge and insight into the state-of-the-art research and development in biotechnology
- a broad knowledge in life sciences including mathematics, chemistry and physics
- in-depth knowledge on advanced technical processes or biological systems in selected areas of biotechnology

Skills and abilities

To receive a Degree of Master of Science in Engineering, the students should:

- demonstrate the ability to develop biotechnical products and processes by applying a systematic thinking in terms of raw materials, energy, security, environment, economy, human conditions and needs, and goals of society for sustainable development
- demonstrate the ability of a scientific approach and analytical thinking and the ability to plan, implement and evaluate experiments
- show a good understanding of methods and techniques that allow modern Biotechnology
- demonstrate the ability to analyze, evaluate and execute the impact of environmental factors on biological system
- demonstrate the ability to orally and in writing, present and discuss ideas and outcomes, communicate and collaborate with persons with or without the technical and scientific background
- demonstrate skills in the economy and leadership
- demonstrate skills and ability, which represent a foundation for postgraduate studies in Biotechnology

Ability to make judgements and adopt a standpoint

To receive a Degree of Master of Science in Engineering, the students should:

- demonstrate a responsible attitude and the ability to take a stand on issues of ethical nature in the application areas of Biotechnology
• demonstrate the ability to rapidly acquire knowledge in new areas and in the field of Biotechnology to apply those for technological innovation and development
• demonstrate the ability to critically review the literature and technologies in Biotechnology and related areas

Extent and content of the programme

The Degree Programme in Biotechnology is composed of 300 credits, which at the normal study speed corresponds to 5 years of full-time studies (10 terms).

The first three years of the programme (180 credits) is in the first cycle and can, if the student applies for it, be finished with a Degree of Bachelor of Science. The final two years (120 credits) are studied at one of the masters programme second cycle that can be selected at the degree programme in Biotechnology and leading to an MSc in Biotechnology / MSc of selected masters programme (see list below of the masters programme that can be selected).

Masters programmes

• Industrial and Environmental Biotechnology
• Medical Biotechnology
• Macromolecular Materials **
• Molecular Science and Engineering **

* The list of masters programmes is subject to change. Updated lists of all masters programmes can be found in the study handbook for the respective study year.

** To obtain Degree of Master of Science in Engineering, courses equivalent to at least 15 credits within Biotechnology, the subject central to the technical area, at advanced level, must be read.

Language of instruction

The language of instruction, during the first three years of the programme is mostly Swedish; although English literature will be used. The concluding two years some courses are given in Swedish and some in English. For each course the language of instruction is found in the Course and program directory on the KTH student web site.

Eligibility and selection

In order to be accepted to the Degree programme, in Biotechnology general eligibility for university studies in Sweden, i.e. completed upper secondary education including documented proficiency in Swedish corresponding to Swedish 3 / Swedish as second language 3 and English corresponding to English 6. as well as the following requirements must be met:

Completed upper-secondary school before 1 July 2011 and adult education at upper-secondary level before July 1, 2012

Area of competence 9 *
Mathematics E
Physics B
Chemistry A
All with at least a grade of P (Pass) or 3.

Completed upper-secondary from 1 July 2011 and adult education at upper-secondary level as of July 1, 2012 (Gy2011)

Area of competence A9 *

Specific requirements:

Physics 2, Chemistry 1 and Mathematics 4. All with at least a grade of P (Pass).

* For more information about “area of competence 9”, see www.hsv.se
For eligibility requirements and selection guidelines, see KTH’s admission policy see www.kth.se

**Implementation of the education**

**Structure of the education**

**Academic year**
The KTH academic year is 40 weeks, divided into four periods. The study periods correspond to about seven weeks. Each study period is followed by an examination period. For details about the structure of the academic year see; "student at kth/timetables" at www.kth.se.

**Study year 1-3, first cycle**
The first three years consists of courses aiming at giving a broad basis of knowledge and skills for an engineer within the field of Biotechnology. The Study programme contains approximately one third courses in Biotechnology, one fifth in Chemistry and one fifth Mathematics. The remainder of the courses cover engineering skills, such as project management, leadership, presentation skills et c., as well as two independent projects and a concluding bachelors level diploma work.

Recommended free elective courses; BB1000 Programming in Python, KD1270 Organic Chemistry, Basic Concepts and Practice 2, KE1185 Chemical Engineering Systems, SF1626 Calculus in Several Variable or language courses.

After completion of 180 credits the student may apply for the Degree of Bachelor of Science if he/she fulfils the national degree requirements.

**Study year 1-2, second cycle**
During study year 1 and 2 the programme continues with courses at second cycle within a Master’s programme, recommended of the degree programme in Biotechnology.

The programme is designed in such a manner that the student after three years of studies can obtain a degree of Bachelor of Science. The student can then continue his/her studies at a Masters programme recommended for the Biotechnology programme, continue his/her studies at another programme at KTH or another university in Sweden or abroad or start his/her work career. If another masters programme than those recommended within the degree programme in Biotechnology are read, the student will not receive a degree certificate in Biotechnology.

**Courses**
The programme is course-based. Lists of courses are included in appendix 1.

**Grading system**
Courses in the first and the second cycle are graded on a scale from A to F. A-E are passing grades, A is the highest grade. The grades pass (P) and fail (F) are used for courses under certain circumstances.

**Conditions for participation in the programme**

**Term registration**
Term registration is required in order for you study results to be registered and for CSN to distribute student aid.

**Course Selection**

**Application to courses**
The student is responsible from study year 1 and on to apply to compulsory, conditionally elective and optional courses which are included in the programme which he/she is studying. Application for admission to courses will be made at:

- 1th-15th of May for the fall term
- 1th-15th of November for the spring term.
Students will be informed about how an application for admission to courses shall be done by the student office. Applications which are submitted after the deadline are only taken into consideration with regards to space considerations. Before course selection of language courses, a test must be taken to determine the appropriate level study.

**Course registration**

Registration of a course requires that the course has been selected in Ladok. The course selection is done either via the course selection routine on the web, or via the BIO students office. Registration for a course is done on the web via "personal menu" or by the course’s department.

The student must, at the first scheduled lecture, register him/herself in the course. Course registration must be done individually at the school giving the course. If the student registers a course and then decides to not continue with the course, then the student must notify the corresponding department as soon as possible.

**Conditions for being promoted to the next level**

The following promotion requirements apply in order to participate in the next level of the education.

**Requirements for promotion from study year 1 to study year 2:**
A total of at least 45 credits from study year 1 to be completed.

**Requirements for promotion from study year 2 to study year 3:**
A total of at least 90 credits from study years 1 and 2 must be completed at least 50 credits from study year 1.

**Requirements for promotion from study year 3 to study year 1 at a Masters Programme:**
A total of at least 150 credits from study years 1-3 must be completed, and at least 110 credits from study year 1-2, and a degree project, first level.

**Requirements for promotion from study year 1 at a Masters Programme to study year 2:**
In addition to what applies for promotion to grade 2, at least 45 credits from study year 1 must be completed.

Students who have not fulfilled the above requirements must consult with their study advisor to construct an individual study plan for the continuation of studies.

**Choice of Masters Program**

Study year 3, the students applies for a Masters programme he/she intends to follow during the last 2 study years.

*For more information about the Masters programme given within the degree programme, in Biotechnology, see descriptions in appendix 2, and programme plans for the masters programme.*

**Admission for Masters programme**

Before the fall term starts, year 2017, the student must have achieved following to start a Masters programme.

- **Requirements for promotion from grade 3 to grade 1, Masters programme:**

  A total of at least 150 credits from study years 1-3 must be completed, and at least 110 credits from study year 1-2, and a degree project, first level, for a degree of bachelor of science.

Students who have not fulfilled the above requirements must consult with their study advisor to construct an individual study plan for the continuation of studies.

**Recognition of previous academic studies**

Students have the opportunity to apply for recognition of their results from the course or courses at another college / university within or outside the country. The form is available on the KTH website. The application for accreditation submitted to the study advisor at the BIO student office.

The complete KTH policy for recognition of previous academic studies is found in the KTH regulations at www.kth.se
Studies abroad

Students at the Degree programme, in Biotechnology have the opportunity to study one or two semesters abroad through agreements KTH has with universities within and outside the EU. Exchange studies is appropriate study year 1 and 2 in second cycle. It is also possible to make the thesis abroad.

For more information see; "student at kth/during a program/study abroad" at www.kth.se or contact the international coordinator at students office.

Degree project

Degree project, first level
In the programme a project work is done in grades 3, a thesis for a Degree of Bachelor of Science which is a course of 15 credits.

Admission to start a degree project, first level, at least 120 credits, included the course

KTH comprehensive rules and guidelines for thesis 15 credits for Degree of Bachelor of Science 180 credits, and grading of the thesis is in the KTHs regulations.

Degree project, advanced level
In the programme a project work is done, a thesis for the Degree of Master of Science in Engineering/Master of Science (120 credits) which is a course of 30 credits. To being working on the thesis, the student must have completed at least 240 higher education credits in the programme.

KTH comprehensive rules and guidelines for thesis 30 credits for Degree of Master of Science in Engineering, Degree Programme in Biotechnology 300 credits, and grading of the thesis is in the KTHs regulations.

For further information see KTH comprehensive rules and guidelines for thesis 30 credits at www.kth.se

Degree

Application for graduation
Students have the opportunity to apply for the following degrees: Degree of Bachelor of Science and Degree of Master of Science in Engineering, Degree Programme in Biotechnology. Students are also able to request for Master of Science (120 credits) of the requirements of this qualification is met.

Students need to apply for degree certificate. To apply use the web service “Application for degrees” that is found in the personal menu.

Conditions for the Degree of Bachelor of Science 180 credits
The Degree of Bachelor of Science is received if the student applies for graduation after the completion of the grade 3 and fulfils the national degree requirements and complete all courses within the program corresponding to 180 credits, of which

- mathematical-natural scientific courses of at least 25 credits,
- at least 90 credits (including 15 credits of degree project work) with the gradual deepening of the main field of education.

Degree Name
Teknologie kandidatexamen
Degree of Bachelor of Science

Conditions for the Degree of Master of Science in Engineering 300 credits
The Master of Science in Engineering degree is received after completing the programme. The programme is formed so that the student fulfils the national degree requirements and has completed courses corresponding to 300 credits, of which
• mathematical-natural scientific courses of at least 45 credits, and, in addition, at least 180 credits (including 30 credits of degree project work) in the subjects central to the technical area
• at least 90 credits in the second cycle, whereof at least 60 credits (including 30 credits of degree project work) in the subjects central to the technical area. To obtain Degree of Master of Science in Engineering, courses equivalent to at least 15 credits within Biotechnology, the subject central to the technical area, at advanced level, must be read.

**Degree Name**
Civilingenjörsexamen
Degree of Master of Science in Engineering, Degree Programme in Biotechnology

**Conditions for Degree of Master of Science (Two Years) 120 credits.**
Degree of Master of Science (Two Years) is received after completing the programme. The programme is formed so that the student fulfils the national degree requirements and has completed courses corresponding to 120 credits, of which

• at least 90 credits in the second level, whereof at least 60 credits (including 30 credits of degree project work) in the subjects central to the technical area

Within the master's programs, the mandatory, recommended, and the conditionally elective courses must correspond to at least 105 credits. The remaining number of credits up to 120, the student can choose freely, but those should be relevant for the profession as an engineer.

**Degree Name**
Degree of Master of Science (120 credits)
Teknologie masterexamen

The introductory courses may not be included in the Degree.

Reference to KTH guidelines (KTHs regulations), local degree ordinance for degrees at first cycle and advanced cycle see www.kth.se

Appendix 1 - Course list
Appendix 2 - Programme syllabus descriptions
Appendix 1: Course list

Degree Programme in Biotechnology (CBIOT), Programme syllabus for studies starting in autumn 2015

General courses

Year 1

Mandatory courses (64.5 credits)

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
<th>Credits</th>
<th>Edu. level</th>
</tr>
</thead>
<tbody>
<tr>
<td>BB1030</td>
<td>Microbiology</td>
<td>9.0</td>
<td>First cycle</td>
</tr>
<tr>
<td>BB1150</td>
<td>Biochemistry 1</td>
<td>7.5</td>
<td>First cycle</td>
</tr>
<tr>
<td>BB1160</td>
<td>Eucaryotic Cell Biology</td>
<td>7.5</td>
<td>First cycle</td>
</tr>
<tr>
<td>BB1170</td>
<td>The Engineer in Focus</td>
<td>6.0</td>
<td>First cycle</td>
</tr>
<tr>
<td>BB1190</td>
<td>Gene Technology</td>
<td>7.5</td>
<td>First cycle</td>
</tr>
<tr>
<td>KD1020</td>
<td>Introductory Chemistry</td>
<td>6.0</td>
<td>First cycle</td>
</tr>
<tr>
<td>KD1230</td>
<td>Organic Chemistry, Basic Concepts and Practice</td>
<td>6.0</td>
<td>First cycle</td>
</tr>
<tr>
<td>KE1180</td>
<td>Introduction to Chemical Engineering</td>
<td>7.5</td>
<td>First cycle</td>
</tr>
<tr>
<td>SF1625</td>
<td>Calculus in One Variable</td>
<td>7.5</td>
<td>First cycle</td>
</tr>
</tbody>
</table>

Optional courses

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
<th>Credits</th>
<th>Edu. level</th>
</tr>
</thead>
<tbody>
<tr>
<td>KE0110</td>
<td>Introductory Course in Chemistry</td>
<td>1.5</td>
<td>Pre-university level</td>
</tr>
<tr>
<td>SF1611</td>
<td>Introductory Course in Mathematics I</td>
<td>1.5</td>
<td>First cycle</td>
</tr>
</tbody>
</table>

Supplementary information

Study year 1 consists of mandatory courses.
Year 2

Mandatory courses (60.0 credits)

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
<th>Credits</th>
<th>Edu. level</th>
</tr>
</thead>
<tbody>
<tr>
<td>BB1170</td>
<td>The Engineer in Focus</td>
<td>6.0</td>
<td>First cycle</td>
</tr>
<tr>
<td>BB1200</td>
<td>Analysis of Biomolecules</td>
<td>6.0</td>
<td>First cycle</td>
</tr>
<tr>
<td>BB1210</td>
<td>Purification of Biomolecules</td>
<td>6.0</td>
<td>First cycle</td>
</tr>
<tr>
<td>BB1220</td>
<td>Project in Biotechnology</td>
<td>6.0</td>
<td>First cycle</td>
</tr>
<tr>
<td>BB1230</td>
<td>Biochemistry 2</td>
<td>6.0</td>
<td>First cycle</td>
</tr>
<tr>
<td>KD1510</td>
<td>Chemical Equilibrium</td>
<td>6.0</td>
<td>First cycle</td>
</tr>
<tr>
<td>SF1524</td>
<td>Basic Numerical Methods and Programming</td>
<td>7.5</td>
<td>First cycle</td>
</tr>
<tr>
<td>SF1624</td>
<td>Algebra and Geometry</td>
<td>7.5</td>
<td>First cycle</td>
</tr>
<tr>
<td>SK1150</td>
<td>Fundamental Physics I</td>
<td>9.0</td>
<td>First cycle</td>
</tr>
</tbody>
</table>

Recommended courses

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
<th>Credits</th>
<th>Edu. level</th>
</tr>
</thead>
<tbody>
<tr>
<td>BB1000</td>
<td>Programming in Python</td>
<td>7.5</td>
<td>First cycle</td>
</tr>
<tr>
<td>KD1270</td>
<td>Organic Chemistry, Basic Concepts and Practice 2</td>
<td>7.5</td>
<td>First cycle</td>
</tr>
<tr>
<td>KE1185</td>
<td>Chemical Engineering Systems</td>
<td>7.5</td>
<td>First cycle</td>
</tr>
<tr>
<td>SF1626</td>
<td>Calculus in Several Variable</td>
<td>7.5</td>
<td>First cycle</td>
</tr>
</tbody>
</table>

Supplementary information

This is a preliminary list of courses for study year 2 for those who started the program 2016. There might be changes.

Study year 2 consists of mandatory courses and an elective course. The course BB1170 continues from study year 1.

Recommended free elective courses;
KD1270 Organic Chemistry, Basic Concepts and Practice 2
SF1626 Calculus in Several Variable
KE1185 Chemical Engineering Systems
BB1000 Programming in Python

Language course

You must study KD1270 Organic Chemistry, basic concepts and practice 2 as one of the free elective courses during study year 2 or 3 or use the free elective credits at the master program to be eligible to take the course KD2310 Advanced Organic Chemistry.

The schedule for study year 2 is adapted for the courses KD1270 Organic Chemistry, Basic Concepts and Practice 2 and SF1626 Calculus in Several Variable.
Year 3

Mandatory courses (60.0 credits)

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
<th>Credits</th>
<th>Edu. level</th>
</tr>
</thead>
<tbody>
<tr>
<td>BB103X</td>
<td>Degree Project in Biotechnology, First Cycle</td>
<td>15.0</td>
<td>First cycle</td>
</tr>
<tr>
<td>BB1170</td>
<td>The Engineer in Focus</td>
<td>6.0</td>
<td>First cycle</td>
</tr>
<tr>
<td>BB1220</td>
<td>Project in Biotechnology</td>
<td>6.0</td>
<td>First cycle</td>
</tr>
<tr>
<td>BB1300</td>
<td>Cultivation Technology</td>
<td>7.5</td>
<td>First cycle</td>
</tr>
<tr>
<td>KD1070</td>
<td>Molecular Structure</td>
<td>6.0</td>
<td>First cycle</td>
</tr>
<tr>
<td>KD1500</td>
<td>Physical Biochemistry</td>
<td>7.5</td>
<td>First cycle</td>
</tr>
<tr>
<td>SF1911</td>
<td>Statistics for Bioengineering</td>
<td>6.0</td>
<td>First cycle</td>
</tr>
<tr>
<td>SI1410</td>
<td>Basic Modeling in Biotechnology</td>
<td>6.0</td>
<td>First cycle</td>
</tr>
</tbody>
</table>

Recommended courses

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
<th>Credits</th>
<th>Edu. level</th>
</tr>
</thead>
<tbody>
<tr>
<td>BB1000</td>
<td>Programming in Python</td>
<td>7.5</td>
<td>First cycle</td>
</tr>
<tr>
<td>KD1270</td>
<td>Organic Chemistry, Basic Concepts and Practice 2</td>
<td>7.5</td>
<td>First cycle</td>
</tr>
<tr>
<td>KE1185</td>
<td>Chemical Engineering Systems</td>
<td>7.5</td>
<td>First cycle</td>
</tr>
<tr>
<td>SF1626</td>
<td>Calculus in Several Variable</td>
<td>7.5</td>
<td>First cycle</td>
</tr>
</tbody>
</table>

Supplementary information

This is a preliminary list of courses for study year 3 for those who started the program 2015. There might be changes.

Study year 3 consists of mandatory courses, elective course and ends with a degree project, first level. The course BB1170 continues from study year 1 and 2. The course BB1220 continues from study year 2.

Recommended free elective courses;
KD1270 Organic Chemistry, Basic Concepts and Practice 2
SF1626 Calculus in Several Variable
KE1185 Chemical Engineering Systems
BB1000 Programming in Python
Language course

You must study KD1270 Organic Chemistry, basic concepts and practice 2 as one of the conditionally elective courses during study year 2 or 3 or use the free elective credits at the master program to be eligible to take the course KD2310 Advanced Organic Chemistry.

The schedule for study year 3 is adapted for the courses KE1185 Chemical Engineering Systems and BB1000 Programming in Python
Year 4

Supplementary information
During study year 4 and 5 one of the four Masters programme should be taken:

- Master - Industrial and Environmental Biotechnology
- Master - Medical Biotechnology
- Master - Macromolecular Materials
- Master - Molecular Science and Engineering

Year 5

Supplementary information
During study year 4 and 5 one of the four Masters programme should be taken:

*Industrial and Environmental Biotechnology*
*Medical Biotechnology*
*Macromolecular Materials*
*Molecular Science and Engineering*

Study year 5 ends with a degree project, second level, 30 credits.
Master, Industrial and Environmental Biotechnology (IMB)

Year 1
Year 2
Year 3
Year 4
Year 5

Master, Medical Biotechnology (MBI)

Year 1
Year 2
Year 3
Year 4
Year 5

Master, Macromolecular Materials (MMM)

Year 1
Year 2
Year 3
Year 4
Year 5

Master, Molecular Science and Engineering (MVT2)

Year 1
Year 2
Year 3
Year 4
Year 5
Appendix 2: Specialisations

Degree Programme in Biotechnology (CBIOT), Programme syllabus for studies starting in autumn 2015

**Master, Industrial and Environmental Biotechnology (IMB)**

The overall goal of this program is that students will gain the insight and knowledge needed to use biotechnology to produce chemicals, materials and energy and thus assist in creating a sustainable society. The program provides a deeper understanding of the metabolic, physiological and genetic basis for the use of enzymes and microorganisms in biotechnological production systems. Understanding of the global pollution and destruction of the environment is an important part of education and to contribute to an improvement in these areas is a major challenge for new engineering graduates. One important tool is an efficient use of biotechnological methods to understand and solve this problem.

For more detailed information about the Master programme (Two Years), Industrial and Environmental Biotechnology, see "student at kth/ course and programme directory" at www.kth.se.

**Master, Medical Biotechnology (MBI)**

The program aims to provide depth in the fields of biotechnology, in which molecular techniques play a central role, with particular emphasis on medical applications. The goal is to provide the prospective civil engineers in biotechnology unique expertise in the border area, chemistry, biology and medicine and provide a high level of competitiveness in the Swedish and foreign labor in the pharmaceutical and biotechnology industries as well as in research. The program includes courses in genomics and proteomics, which contains a large number of technical methods for analyzing cell activity on DNA, RNA and protein level. Bioinformatics provides an insight into how the huge amounts of data produced can be handled by computers. The program also includes courses that provide knowledge about the structure of biomolecules can be determined and how the process looks to develop drugs from the first discovery of an active molecule.

For more detailed information about the Master programme (Two Years), Medical Biotechnology, see "student at kth/ course and programme directory" at www.kth.se

**Master, Macromolecular Materials (MMM)**

To obtain the Degree of Master of Science in Engineering, Degree Programme in Biotechnology, the student must take 2 of these courses;

- BB2460 Biocatalysis, 7.5 credits
- BB2020 Molecular Enzymology7.5 credits
- BB2420 Glycobiology and Carbohydrate Technology, 7.5 credits

For more detailed information about the Master programme (Two Years), Macromolecular Materials, see "student at kth/ course and programme directory" at www.kth.se.

**Master, Molecular Science and Engineering (MVT2)**

To obtain the Degree of Master of Science in Engineering, Degree Programme in Biotechnology, the student must take these courses;

- BB2460 Biocatalysis, 7.5 credits
- BB2020 Molecular Enzymology7.5 credits
For more detailed information about the Master programme (Two Years), Molecular Science and Engineering, see "student at kth/ course and programme directory" at www.kth.se.