Programme syllabus

Master's Programme, Computational and Systems Biology, 120 credits
Masterprogram, beräknings- och systembiologi
120.0 credits

Valid for students admitted to the education from autumn 09 (HT - Autumn term; VT - Spring term).

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

Programme objectives

The program gives students knowledge, skills and networks to continue on entrepreneurial, engineering or research leader tracks to the biotech and pharmaceutical industries and to academia in the post-genome and bio-simulation era.

Knowledge and understanding

A Master of Science in Computational and Systems Biology will:

- have an advanced understanding of methods and results in Computational and Systems Biology
- have a solid base in bio-modeling, including using modeling tools and common operating systems
- have a solid base in bioinformatics, including knowing about the most important genomic data bases, practical know-how in using them, and understanding central bioinformatic algorithms
- have a basic understanding of industrial management, entrepreneurship and project management

Skills and abilities

A Master of Science in Computational and Systems Biology will:

- be able to follow and develop best practice methods in industry, administration and academic research, especially in the Biotech and Bio/IT sector
- be able to independently define and solve modeling problems posed in Biology
- be able to work independently as a bioinformatician, including constructing simpler algorithms as well as modifying and adapting algorithms in the scientific and technical literature
- be able to work in medical or bio-science research or project teams, and contribute the modeling and bioinformatic competence
• be able to work successfully in international multidisciplinary teams consisting of both technical and business/entrepreneurial team members, and to have the necessary skills in spoken and written English
• have basic skills in project planning, project management and project review and assessment in a small-company setting

Ability to make judgements and adopt a standpoint

A Master of Science in Computational and Systems Biology will be able to:

• independently analyse and relate to economic, environmental and ethic consequences of applications of computational and systems biology, and to design systems and solutions with this in mind
• by self-development retain his or her professional skills over a career
• follow discussion on technology and uses of technology in society and contribute to the same

Extent and content of the programme

Computational and Systems Biology is a two-year (120 ECTS credits) master programme on the advanced level (second level). The instruction language is entirely English. The programme consists of a basic curriculum followed by three specialization streams: (i) Biomodeling, (ii) Bioinformatics, and (iii) Biotech and entrepreneurship. The courses in the basic curriculum are compulsory and constitute about half of the credit points. To obtain sufficient depth in a specialization, a student is normally required to complete courses worth at least 15 ECTS credits among the profile courses for the specialization stream in question.

Eligibility and selection

General admission requirements
A completed Bachelor's degree, equivalent to a Swedish Bachelor's degree (180 ECTS credits), from a university recognized by the Swedish government or accredited by some other recognized organization. A good knowledge of written and spoken English.

Specific admission requirements
The prerequisite for the Master’s programme in Computational and Systems Biology is a Swedish or foreign degree equivalent to Bachelors degree of 180 ECTS credits, with credits in the following subjects: multivariate calculus, linear algebra, and computer science including programming.

Applicants must also provide a proof of good knowledge in English, equivalent to Eng B (Swedish school system).
For more information, see Study at KTH, Master’s programmes at KTH, “Admission requirements”.

Selection process
The selection process for the Master of Science programme in Computational and Systems Biology is based on a total evaluation of the following selection criteria: university, grades (Grade Point Average), course work related to the programme, working experiences and references.

Applicants are strongly advised to attach Graduate Record Examination scores (GRE General Test as well as one of GRE Subject Tests in either Computer Science, Physics, Mathematics or Biochemistry, Cell and Molecular Biology), to assist the evaluation committee in assessing how the selection criteria are met.
Complete information on the eligibility requirements can be found in the local admission policy of KTH, see:

http://intra.kth.se/regelverk/utbildning-forskning/grundutbildning/antagning/1.27192

**Implementation of the education**

**Structure of the education**

The academic year has a duration of 40 weeks. The academic year at KTH is divided into four periods. Each period lasts approximately seven weeks. Each period is followed by an exam period.

The first year in the programme is mainly dedicated to the compulsory courses in the basic curriculum. The second year mainly consists of elective courses and the final degree project.

**Courses**

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

The programme is course-based with strong features of computer labs and projects, oral presentations and lectures, written reports, take-home exams and regular written exams. A list of courses is included in Appendix 1. The basic curriculum in year 1 consists mainly of compulsory courses. In year 2 only one course is compulsory. In the chosen specialization at least 15 ECTS credits have to be taken.

**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**

No later than November 15 and May 15 each academic year, respectively, the students are required to make a study registration and course selection for the coming term. At least 45 ECTS credits have to be completed during the first academic year (including the re-examination period in August) in order for the student to be promoted to the second year of the programme. Students have to make a decision about the specialization stream during the first year of the programme.

**Recognition of previous academic studies**

Under certain circumstances, and in agreement with the programme director, credits for previous studies can be received according to the local policy of KTH, see

http://intra.kth.se/regelverk/utbildning-forskning/grundutbildning/prestationer/1.27200

**Studies abroad**
Under certain circumstances, and in agreement with the programme director, studies may be conducted at other universities in Sweden or outside Sweden. Credits can be received according to the local policy of KTH, see

http://intra.kth.se/regelverk/utbildning-forskning/grundutbildning/utbytesstudier/1.27222

**Degree project**

Students admitted to the programme are required to perform an individual study in the form of a thesis project corresponding to 30 ECTS credits. The main portion of the studies must generally be completed before the degree project work can be started. At least 60 ECTS credits for the mandatory course work whereof 10 ECTS credits of the profile courses in the specialization must be completed. The purpose of the thesis project is that the student demonstrates the ability to perform independent project work, using the skills obtained from the courses in the programme. It is the student's responsibility to find a suitable thesis project, with assistance from KTH.

More information on the KTH policy on the degree project can be found at:
http://intra.kth.se/polopoly_fs/1.27212!/riktlinjermalkriteriermaster.pdf

**Degree**

Degree of Master of Science (Two Years) - is obtained after completion of the Master (Two Years), **Computational and Systems Biology** study programme. The programme is designed so that students, when they graduate, have fulfilled national requirements for a degree and have completed courses comprising 120 ECTS credits, of which:

- At least 90 ECTS credits are at second level, of which at least 60 ECTS credits (including a 30- ECTS credits degree project) with in-depth studies in the main field of study.

Students who fulfil all the requirements will be awarded a Degree of Master of Science (Two Years). Students must apply for the degree and also show proof of their basic degree (Bachelor or similar) and have paid the student union fee.

**Degree name**

*Degree of Master of Science (Two Years)*

*Teknologie masterexamen (Två år)*

http://intra.kth.se/regelverk/utbildning-forskning/grundutbildning/examina/1.27227?l=en_UK

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

Master's Programme, Computational and Systems Biology, 120 credits (TBSBM), Programme syllabus for studies starting in autumn 2009

General courses

Year 1

Mandatory courses (51.0 Credits)

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
</tr>
</thead>
<tbody>
<tr>
<td>DA2205</td>
<td>Introduction to the Philosophy of Science and Research Methodology</td>
</tr>
<tr>
<td>DD2397</td>
<td>Applied Bioinformatics</td>
</tr>
<tr>
<td>DD2398</td>
<td>Quantitative Systems Biology</td>
</tr>
<tr>
<td>DD2399</td>
<td>Omic Data and Systems Biology</td>
</tr>
<tr>
<td>DD2435</td>
<td>Mathematical Modelling of Biological Systems</td>
</tr>
<tr>
<td>DD2450</td>
<td>Algorithmic Bioinformatics</td>
</tr>
<tr>
<td>SK2530</td>
<td>Introduction to Biomedicine</td>
</tr>
</tbody>
</table>

Recommended courses

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
</tr>
</thead>
<tbody>
<tr>
<td>DD2400</td>
<td>Cellular and Molecular Biology</td>
</tr>
<tr>
<td>DD2401</td>
<td>Neuroscience</td>
</tr>
<tr>
<td>DD2432</td>
<td>Artificial Neural Networks and Other Learning Systems</td>
</tr>
<tr>
<td>DD2447</td>
<td>Statistical Methods in Applied Computer Science</td>
</tr>
<tr>
<td>ME2806</td>
<td>From Science to Business</td>
</tr>
</tbody>
</table>

Supplementary information

During the spring term (at least) 9 higher education credits of recommended, or elective, courses are chosen.
### Year 2

#### Mandatory courses (60.0 Credits)

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
<th>Credits Edu. level</th>
</tr>
</thead>
<tbody>
<tr>
<td>DD225X</td>
<td>Degree Project in Biomedical Engineering, Second Cycle</td>
<td>30.0 hp Second cycle</td>
</tr>
<tr>
<td>ME202X</td>
<td>Degree Project in Industrial Management, Second Cycle</td>
<td>30.0 hp Second cycle</td>
</tr>
</tbody>
</table>

#### Recommended courses

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
<th>Credits Edu. level</th>
</tr>
</thead>
<tbody>
<tr>
<td>DD2257</td>
<td>Visualization</td>
<td>7.5 hp Second cycle</td>
</tr>
<tr>
<td>DD2354</td>
<td>Algorithms and Complexity</td>
<td>6.0 hp Second cycle</td>
</tr>
<tr>
<td>DD2390</td>
<td>Internet Programming</td>
<td>6.0 hp Second cycle</td>
</tr>
<tr>
<td>DD2431</td>
<td>Machine Learning</td>
<td>6.0 hp Second cycle</td>
</tr>
<tr>
<td>EN2202</td>
<td>Pattern Recognition</td>
<td>7.5 hp Second cycle</td>
</tr>
<tr>
<td>EN2500</td>
<td>Information Theory and Source Coding</td>
<td>7.5 hp Second cycle</td>
</tr>
<tr>
<td>ME2016</td>
<td>Project Management: Leadership and Control</td>
<td>6.0 hp Second cycle</td>
</tr>
<tr>
<td>ME2018</td>
<td>Leading Temporary Organizations and Projects</td>
<td>6.0 hp Second cycle</td>
</tr>
<tr>
<td>ME2024</td>
<td>Industrial Marketing, Advanced Course</td>
<td>6.0 hp Second cycle</td>
</tr>
<tr>
<td>ME2035</td>
<td>Globalization of Industry and Technology, Advanced Course</td>
<td>6.0 hp Second cycle</td>
</tr>
<tr>
<td>ME2800</td>
<td>Ideation - Creating a Business Idea</td>
<td>7.5 hp Second cycle</td>
</tr>
<tr>
<td>ME2801</td>
<td>Planning - Developing a Venture</td>
<td>7.5 hp Second cycle</td>
</tr>
<tr>
<td>ME2802</td>
<td>Execution - Running your own Company</td>
<td>7.5 hp Second cycle</td>
</tr>
<tr>
<td>ME2803</td>
<td>Growth - Managing Your Firm</td>
<td>7.5 hp Second cycle</td>
</tr>
<tr>
<td>SF1811</td>
<td>Optimization</td>
<td>6.0 hp First cycle</td>
</tr>
<tr>
<td>SK2520</td>
<td>Experimental Methods in Molecular Biophysics</td>
<td>8.0 hp Second cycle</td>
</tr>
</tbody>
</table>

#### Supplementary information

Specialization streams are:

1. Biomodeling
2. Bioinformatics
3. Biotech and Entrepreneurship

DD225X is compulsory within 1. and 2., ME202X within 3.

Within the chosen stream at least 15 higher education credits of recommended courses must be chosen:

1. DD2431, DD2257, EN2202, SK2520, SF1811, at Stockholm University: FK3008 Biostatistics for Physicists
2. DD1352/DD2354, DD2431, DD2390, BB2320, BB2250, EN2202, EN2500, SF1811, SF2960, at Stockholm University: FK3008 Biostatistics for Physicists, and KB8007 Comparative Genomics
3. ME2018, ME2024, ME2035, ME2800, ME2801, ME2802, ME2803, ME2804, DD2431, DD2390

Some courses are given every other year.
Appendix 2: Specialisations

Master's Programme, Computational and Systems Biology, 120 credits (TBSBM), Programme syllabus for studies starting in autumn 2009

This programme has no specialisations.