Programme syllabus

Master's Programme, Systems Biology, 120 credits
Masterprogram, systembiologi
120.0 credits

Valid for students admitted to the education from autumn 11 (HT - Autumn term; VT - Spring term).

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

Programme objectives

The Systems biology program is an Erasmus Mundus program operated in cooperation by KTH, Helsinki University of Technology (TKK, Finland) and Instituti Superior Técnico (IST, Portugal).

Systems biology is defined as the study of the interactions between the components of a biological system and how these interactions give rise to the function and behavior of the system. Research areas include (most forms of) cancer and (most) neurological and psychiatric disorders.

The euSYSBIO program gives the students a solid background in methodological sciences and hands-on experience in measurement technologies, so that they can cope with the expected future demands of a systems biology specialist.

Knowledge and understanding

A master in systems biology shall

- have a solid understanding of computational modelling and systems biology,
- have the necessary understanding of the underlying biology in order to apply and interpret computational methods in the context of systems biology.

Skills and abilities

A master in systems biology shall

- have had hands-on experience in current measurement techniques in systems biology,
- be able to apply the methods in practical research,
- be able to design and implement mathematical and statistical models of complex computational systems.

Ability to make judgements and adopt a standpoint

A master in systems biology shall

- be able to make judgements within the systems biology field considering relevant scientific, societal, and ethical aspects,
- have an understanding of the possibilities and limitations of science, its role in society and the responsibility for its use,
- be able to identify the need for further knowledge in the field and take responsibility for keeping his/her personal knowledge up to date.

In addition to this the similar objectives for master degree defined in the Higher Education Ordinance (Högskoleförordningen) are applicable.
Extent and content of the programme

Systems biology, euSYSBIO, is a two-year (120 ECTS credits) master program on the advanced level (second cycle). The instruction language is English. Some elective courses are given in Swedish.

A joint curriculum is defined which involves always two universities. One university, here denoted the "home university" offers the first year (60 ECTS credits), and a second university, here denoted the "host university", offers the second year (60 ECTS credits).

The program has two home universities, KTH (Stockholm, Sweden) and TKK (Espoo, Finland). In the theoretical subjects, the curricula for the first year studies are compatible, but with some emphasis on the particular strengths of the universities. At KTH the emphasis is on modelling of dynamic phenomena and on algorithmic bioinformatics; at TKK, the emphasis is on statistical modelling methodology and machine learning. Both first year curricula include experimental courses.

All universities in the program are host universities, and offer one specialized (second-year) course each. The second-year courses have a uniform format comprising one semester (30 ECTS credits) of specialized courses, and one semester (30 ECTS credits) degree project. To enforce consistency of evaluation and requirement across the program, degree projects will be evaluated both by the home university and by the host university. The project will be carried out from the topic of specialization of each of the universities:

KTH: “Science of Life Labs” and Computational Neuroscience (two tracks)

TKK: Computational modelling in systems biology

IST: Systems Biology of Stress Response and Biotechnology

Eligibility and selection

Minimum admission requirements

- A degree equivalent to a Bachelors degree of 180 ECTS credits, with credits in the following subjects: multivariate calculus, linear algebra and computer science including programming.
- Evidence of English language proficiency

For details please see:

http://www.kth.se/studies/master/em/eusysbio/application/admission-requirements-for-eusysbio

Applicants who fulfill the minimum general and specific requirements are ranked using a series of selection criteria: university, content of degree/s, study success, motivation letter, references, relevant work experience, publications (including scientific posters etc) and proficiency in English.

For details please see:

http://www.kth.se/studies/master/em/eusysbio/application/selectionprocess

Implementation of the education

Structure of the education

The education comprises not only studies at the home and host universities but also a horizontal integration between students in the same study year but different universities and a vertical integration between students in the first year and students in the second year of studies.

The program administers an annual winter school paid for by the consortium. A number of teachers from the partner universities and international lecturers are invited.
Horizontal integration for study year one is achieved by interchange (visits) between Stockholm and Helsinki, by participation in the winter school and by a joint oral examination of all students from KTH and TKK. Horizontal integration for study year two is achieved by participation in the winter school.

Vertical integration is achieved by participation in the winter school and by joint examination of the degree project (home university and host university).

The duration of the academic year at KTH is 40 weeks, divided into four periods. If necessary education may occur outside of the academic year.

More information can be found at http://www.kth.se/student/schema/1.1007

Courses

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

Courses are examined in many ways, for example by home assignments that are presented either using oral presentations or written reports, computer assignments, project work or traditional written exams.

After each course a student evaluation is performed and then analyzed by the course leader in the course analysis document, which is normally published on the web, see the KTH regulations of course analyses: http://intra.kth.se/regelverk/utbildning-forskning/grundutbildning/kursanalys

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.

Students will be given grades both according to the system of the home/host university and according to ECTS user's guide.

Conditions for participation in the programme

Students must follow the rules that apply for the university where they are studying. The consortium requires the students to pass a joint oral examination by KTH and TKK to be promoted to study year 2.

Recognition of previous academic studies

Credits for studies at another university can be received. An application form can be found on the KTH Student pages.

The application form is submitted to the CSC Program Office.

For in-depth information about the KTH policy for crediting previous studies, see http://intra.kth.se/regelverk/utbildning-forskning/grundutbildning/prestationer/1.27200

Studies abroad

Study year one is taken at the home university in one country and study year two is taken at the host university in a different country.

Degree project

Students on the euSYSBIO program perform an individual degree project.

After completion of the degree project the student shall have the ability to independently carry out a project using the knowledge and skills acquired through the courses. The degree project is carried out at the host university and is supervised by teachers both from the home university and the host university. The project task may be theoretical or practical focusing on research, implementation or applications. The origin of the project task may be industry or academia.
The consortium will strive for a harmonization between the partner universities as to grading of the degree projects and the supervisors from the home and host university will confer. Grading of the degree project for the two degrees that the student receives (home and host university) will be done according to the rules of the university giving the degree but considering the consultation between the supervisors.

It is the responsibility of the student to find a suitable project task.

More information about the rules for degree projects at KTH can be found at http://intra.kth.se/regelverk/utbildning-forskning/grundutbildning/examensarbete/1.27212

**Degree**

Students with KTH as home or host university can apply for a Degree of Master of Science (two years).

Information on the application process can be found on the KTH Student pages.

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

Master's Programme, Systems Biology, 120 credits (TSYBM), Programme syllabus for studies starting in autumn 2011

**General courses**

**Year 1**

**Mandatory courses (58.0 credits)**

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
<th>Credits</th>
<th>Edu. level</th>
</tr>
</thead>
<tbody>
<tr>
<td>BB1110</td>
<td>Gene Technology and Molecular Biology</td>
<td>7.0</td>
<td>First cycle</td>
</tr>
<tr>
<td>BB2160</td>
<td>Structure Biology</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>DD2397</td>
<td>Applied Bioinformatics</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>DD2398</td>
<td>Quantitative Systems Biology</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>DD2399</td>
<td>Omic Data and Systems Biology</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>DD2435</td>
<td>Mathematical Modelling of Biological Systems</td>
<td>9.0</td>
<td>Second cycle</td>
</tr>
<tr>
<td>DD2450</td>
<td>Algorithmic Bioinformatics</td>
<td>6.0</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SK2530</td>
<td>Introduction to Biomedicine</td>
<td>6.0</td>
<td>Second cycle</td>
</tr>
</tbody>
</table>

**Supplementary information**

Students studying their first year at KTH take the courses listed below. They also take the course "What is life? The future of biology", 2 cr, given by Karolinska Institutet.

**Year 2**

**Mandatory courses (67.5 credits)**

<table>
<thead>
<tr>
<th>Course code</th>
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<th>Credits</th>
<th>Edu. level</th>
</tr>
</thead>
<tbody>
<tr>
<td>BB2290</td>
<td>Molecular Biomedicine</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>BB2510</td>
<td>Proteomics</td>
<td>6.0</td>
<td>Second cycle</td>
</tr>
<tr>
<td>DD225X</td>
<td>Degree Project in Biomedical Engineering, Second Cycle</td>
<td>30.0</td>
<td>Second cycle</td>
</tr>
<tr>
<td>DD2402</td>
<td>Advanced Individual Course in Computational Biology</td>
<td>6.0</td>
<td>Second cycle</td>
</tr>
<tr>
<td>Course code</td>
<td>Course name</td>
<td>Credits</td>
<td>Edu. level</td>
</tr>
<tr>
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</tr>
<tr>
<td>DD2403</td>
<td>Advanced Individual Course in Computational Biology</td>
<td>9.0</td>
<td>Second cycle</td>
</tr>
<tr>
<td>DD2435</td>
<td>Mathematical Modelling of Biological Systems</td>
<td>9.0</td>
<td>Second 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>BB2280</td>
<td>Molecular Modeling</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>BB2300</td>
<td>Computational Chemistry</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>BB2470</td>
<td>Genetics and Genomics</td>
<td>10.0</td>
<td>Second cycle</td>
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<tr>
<td>DD2380</td>
<td>Artificial Intelligence</td>
<td>6.0</td>
<td>Second cycle</td>
</tr>
<tr>
<td>DD2447</td>
<td>Statistical Methods in Applied Computer Science</td>
<td>6.0</td>
<td>Second cycle</td>
</tr>
<tr>
<td>DN2266</td>
<td>Mathematical Models, Analysis and Simulation Part 1</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>EL2320</td>
<td>Applied Estimation</td>
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<td>Second cycle</td>
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<tr>
<td>EL2620</td>
<td>Nonlinear Control</td>
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<td>Second cycle</td>
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<tr>
<td>SF2940</td>
<td>Probability Theory</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SI2700</td>
<td>Protein Physics</td>
<td>7.5</td>
<td>Second cycle</td>
</tr>
<tr>
<td>SK2520</td>
<td>Experimental Methods in Molecular Biophysics</td>
<td>8.0</td>
<td>Second cycle</td>
</tr>
</tbody>
</table>

### Supplementary information

Two tracks are within the programme:

1. Molecular systems biology
2. Computational Neuroscience.
Appendix 2: Specialisations

Master's Programme, Systems Biology, 120 credits (TSYBM), Programme syllabus for studies starting in autumn 2011

This programme has no specialisations.