General study plan for the doctoral program in

Biotechnology

School of Biotechnology, KTH

Revised version September 2016 (previous version established October 2010)

Content

1. Name of the subject

The subject is *Biotechnology*.

Biotechnology can be described as an integration of natural sciences and engineering to exploit organisms, cells, parts thereof or molecular equivalents, or knowledge thereof, for the development of products and processes. Furthermore, the United Nations (UN) definition of biotechnology reads: *"Technological applications using biological systems, living organisms, or derivatives thereof, to manufacture or modify products or processes for special uses"*. The subject area is by nature broad and interdisciplinary, which is also reflected in the names of the five departments within the School of Biotechnology at KTH, which have active main supervisors for postgraduate students in the program: Industrial and Environmental Biotechnology, Proteomics and Nanobiotechnology, Gene Technology, Protein Technology and Carbohydrate Science, which conduct research and method development in a number of areas including *e.g.,* cellular physiology and metabolism, modeling of molecules, cells and processes, cell lines and processes for bioproduction, design and *in vitro* evolution of proteins, techniques for cellular and molecular analysis/characterization/diagnostics, mapping and analysis of genomes, transcriptomes and proteomes, population genetics, enzymology, plant genetics and physiology and carbohydrate/cellulose chemistry. The applied bioinformatics has also emerged as an increasingly integrated part of biotechnology and contributes with critical skills in managing and interpreting large amounts of data from a biological perspective.

Possible areas of application of the research are many and include, for example, production of green chemicals, biofuels, new materials and drugs, development of methodology for clinical and investigational *in vitro*- and *in vivo*- diagnostics, personalized medication, water purification, environmental monitoring, bioseparation and forest biotechnology.

2. Main content of education in the subject

Postgraduate studies in the subject *Biotechnology* are conducted without subdivision in underlying directions and may have either a licentiate degree (120 credits, equivalent to two years full-time studies) or a doctorate (240 credits, equivalent to four years full-time studies) as a goal. In both cases, the education contains both a course part of 30 and 60 credits, respectively (see section 5) and a licentiate/doctoral thesis part of 90 and 180 hp, respectively (see section 7).

The thesis part of the education is based on an accumulation of own theoretical and/or experimental data in the current research field, which leads to the completion of a written licentiate/doctoral thesis that can be defended at a licentiate seminar or a dissertation at the end of the research studies.

The education is conducted in accordance with the KTH regulations for postgraduate studies (https://intra.kth.se/styrning/regelverk) where current information/regulations are available regarding admission, different study funding options, requirements for appointment as principal supervisor/assistant supervisor (co-supervisor), study follow-up, termination of studies, discontinuation of studies, cancellation of resources, regulations for collaboration in postgraduate

education, procedures for licentiate/doctoral theses, requirements for examiner/opponent and grading committee member, licentiate/doctoral thesis format and distribution, degree system, regulation regarding conflicts of interest, etc.

The education is under the guidance of a principal supervisor together with one or more co-supervisors, in accordance with a so-called Individual Study Plan (ISP), which is updated at least once a year (or more often if necessary) for review and approval by the director of postgraduate studies.

3. Objectives for the education

The aim of the education is to provide society with qualified researchers who can contribute to sustainable societal development.

At the examination, both the general objectives for postgraduate education according to the Higher Education Ordinance (see Appendix 1) and the local KTH goals must be met. To promote the achievement of these goals during the study period, all PhD students and supervisors are requested, at the time of admission to research studies, to formulate concrete and monitorable individual and subject-customized versions of these goals (see Appendix 2 for instructions and advice). In the mandatory annual revision of the Individual Study Plan (ISP), the PhD student and supervisor shall jointly, in writing, evaluate the PhD student's progression towards these goals, and if necessary, revise them. Appropriate measures (for example, courses) should be proposed when needed to ensure continued development towards fulfillment of the goals.

To further promote that good quality of the education and the licentiate/doctoral thesis is achieved, that also adheres to the guidelines of the subject study plan herein (see sections 5 and 7), it is advised that PhD students with a doctorate as a goal, after approximately two years of research studies, either sum up their achieved results in a licentiate thesis defended at a licentiate seminar, or hold a two-year seminar. At a two-year seminar (approx. midterm seminar), the doctoral student sums up the results achieved so far, which are presented at a seminar where future plans are also reported. This presentation is followed by a constructive discussion between the doctoral student, supervisor, co-supervisor and two invited senior researchers/supervisors at the School of Biotechnology where the projects, the doctoral student's ISP and the future plans are reviewed.

4. Requirements for special eligibility

The eligibility requirements for admission follow KTH's general admission regulations for postgraduate education at KTH (see KTH's regulations). No other requirements for *special eligibility* exist, except for proficiency in English at a level that is sufficient for the student to assimilate English literature, frame and normally defend the thesis in English.

5. Extent and content of the course curriculum

5.1 General rules

For a licentiate degree, a course part of at least 30 credits is included, and a doctoral degree comprises a course part of at least 60 credits. The choice of courses will be discussed and agreed with the principal supervisor.

Courses can be arranged by the home university (KTH), or any other national or international university, institute or company. Note that the quality and level of courses organized by organizations other than universities (including online courses regardless of organizer) must be reviewed and approved by the director of postgraduate studies before they can enter into the course curriculum of an individual study plan.

In accordance with the KTH local degree system, for the 30 hp requirement for a licentiate degree:

- At least 15 credits must be at the doctoral level
- A maximum of 10 credits may be at the first level

In accordance with the KTH local degree system, for the 60 hp requirement for a doctoral degree:

- At least 45 credits must be at the doctoral level
- A maximum of 10 credits may be at the first level

Also note that according to the regulations above, a second category of undergraduate courses called "advanced-level courses" (normally master's courses) can be included for both licentiate and doctoral degree in the part of the courses that are not at the research level, but not more than 15 credits.

5.2 Compulsory courses

A number of courses are compulsory for all postgraduate students in the subject *Biotechnology*:

(a) Course in basic higher education pedagogy

In accordance with KTH's regulations for education at the postgraduate level, courses in basic higher education pedagogy are compulsory for both licentiate and doctoral degrees at KTH, including the subject *Biotechnology*:

"If the doctoral student is to teach at undergraduate or advanced level, courses with a focus on basic higher education pedagogy should be included in the individual study plan, alternatively, the corresponding knowledge must have been acquired otherwise. Courses in basic higher education pedagogy should be completed before the start of teaching"

Courses given in this subject at KTH include:

- LH200V Basic Communication and teaching (3 credits)
- LH231V Teaching and learning in higher education (7,5 credits)

(b) Seminar courses

Participation in seminar courses including presentation, interpretation and critical review of ongoing research projects as well as internationally published papers is compulsory for both licentiate and doctoral degrees in the subject *Biotechnology*.

For both licentiate and doctoral degrees, the individual study plan must comprise 6 credits from seminar courses.

5.3 Recommended courses

Courses in science theory and scientific methodology are recommended for those graduate students who have not studied such a course during their undergraduate education.

Courses given in this subject at KTH include:

- 1N5113 Theory of Science and Research Method, Technological and Natural Sciences (7,5 credits)
- AK3024 Introduction to Theory of Science and Research Methodology, for Graduate Students in Technology and Natural Sciences (4.5 credits)

5.4 Qualifications from oral presentations and poster contributions

In order to promote scientific exchange for postgraduate students, active participation in the form of oral presentation or poster contribution at major national and international conferences, workshops and summer schools is encouraged, and entitles students to a degree in postgraduate education in the subject *Biotechnology* according to the following: 1,5 credits for oral presentation; 0,5 hp for poster contribution; max 5,0 credits in total during the postgraduate period. This applies both to students with a licentiate degree or a doctorate as a goal.

5.5 Acceptance of courses read prior to admission to postgraduate education

Under certain conditions, courses taken by the student prior to admission to postgraduate education at KTH may be counted as part of the course requirements, after approval by the principal supervisor and director of postgraduate studies. Crediting of courses taken as part of education that constitutes a prerequisite for postgraduate studies cannot be invoked, and which did not cover more than 240 credits.

6. Courses and seminars

For doctoral students belonging to the doctoral program in biotechnology, a series of courses and seminars series are offered at the postgraduate level in various disciplines of the subject area, and are organized by the faculty of Biotechnology, KTH. The postgraduate courses are intended to give a deeper understanding of various key areas within the subject area. These courses can be

complemented with other courses at the undergraduate level, advanced level and postgraduate education level both within and outside of KTH, including courses in pedagogy and scientific methodology.

The research education is for the most part individually adapted to the student's need for knowledge and the specific research project. The doctoral program, however, places strong emphasis on providing a research school-like environment incorporating interactive and socially inclusive activities. Participation in seminar series during the study period (minimum of 6 credits) is therefore mandatory. These include presentation, interpretation and critical review of ongoing research projects, as well as internationally published work in a group of postgraduate students with different main supervisors (see section 5.2b above).

7. Extent of theses for a licentiate and doctorate degree

A licentiate/doctoral thesis is a compulsory part of the education at the research level. In addition to the general review process at KTH regarding the quality of licentiate/doctoral thesis, the following criteria, representing a scientific practice and norm, shall apply as guidelines for the extent and quality of licentiate and doctoral theses. Circumstances that make these criteria to be non-applicable or inconsequential should be discussed with the director of postgraduate studies and school director at the School of Biotechnology, KTH.

- DOCTORAL THESIS -

Compilation thesis

- The doctoral thesis is usually based on four articles.
- Normally, two of the articles should either be published or formally accepted for publication ("in press") in international reviewed ("peer-reviewed") scientific journals.
- Other articles may be included as manuscripts, preferably submitted for publication in international peer-reviewed journals.
- The postgraduate student should appear as the first author of at least two of the included articles, including one of the articles belonging to the "already published or accepted for publication" category.
- For each of the included articles, the student's own contribution must be significant and clearly identifiable.
- The thesis must be reviewed in advance by at least one senior researcher and the principal supervisor before being printed.
- In cases where a thesis is based solely on manuscripts that have not yet been published or accepted for publication in peer-reviewed journals, the thesis and the included manuscripts must be reviewed by at least one senior researcher, principal supervisor, opponent and doctoral committee before being printed.

Monograph

- Monograph theses should be avoided. KTH has an explicit ambition that the content of theses should be acceptable for publication in peer-reviewed scientific journals.
- The thesis must be reviewed in advance by at least two senior researchers, the principal supervisor and the director of postgraduate studies before being printed.

- LICENTIATE THESIS -

Compilation thesis

- The licentiate thesis is usually based on two articles.
- The included articles need not already be published or formally accepted for publication ("in press") in international reviewed ("peer-reviewed") scientific journals.
  However, normally at least one of the included articles should be submitted for publication in an international peer-reviewed scientific journal.
- The postgraduate student should appear as the first author of at least one of the articles in question.
- The postgraduate student should appear as the first author of at least one of the included articles.
- For each of the included articles, the student's own contribution must be significant and clearly identifiable.
- If the thesis contains one or more articles that have already been published or accepted for publication ("in press") in peer-reviewed scientific journals, the thesis must be reviewed by at least one senior researcher and the principal supervisor before being printed.
- If the thesis does not contain an article that has already been published or accepted for publication ("in press") in peer-reviewed scientific journals, the thesis must be reviewed by at least two senior researchers and the principal supervisor before being printed.

Monograph

- Monograph theses should be avoided. KTH has an explicit ambition that the content of theses should be acceptable for publication in peer-reviewed scientific journals.
- The thesis must be reviewed in advance by at least two senior researchers, the principal supervisor and the director of postgraduate studies before being printed.