

## Appendix A

## CLUSTER Dual Master Agreement between

Kungliga Tekniska högskolan (KTH) and Université Catholique de Louvain (UCL)

Duration: Academic Year 14/15 to 18/19

Degree programme at KTH:	<b>Master's Program in Applied and Computational Mathematics (120 ECTS)</b>
Degree awarded:	M.Sc.
Language of instruction	English
Entrance admission criteria:	Bachelor's degree in Science or Engineering
Degree programme at UCL:	<b>Master's Program in Mathematical Engineering (120 ECTS)</b>
Degree awarded:	Master in Mathematical Engineering (Master : ingénieur civil en mathématiques appliqués)
Language of instruction	French/English
Entrance admission criteria:	Bachelor's degree in Science or Engineering
Number of students	2

## Schematic Study Plan

Option 1			
Year	Institution	Studies	Remarks
1	UCL	Compulsory and elective courses	60 ECTS
2	KTH	Courses + Master Thesis (examiner at both universities)	30+30 ECTS
Option 2			
Year	Institution	Studies	Remarks
1	KTH	Compulsory and elective courses	60 ECTS
2	UCL	Courses + Master Thesis (examiner at both universities)	30+30 ECTS
<b>The schematic study plan is applicable to students originated from UCL or KTH indifferently. The detailed study plan must be defined by the academic coordinators for each student.</b>			

## Contacts:

Academic responsible for the programme at KTH: Assoc. Prof. Filip Lindskog	Academic responsible for the programme at UCL: Prof. Vincent Blondel
Contact person: Assoc. Prof. Filip Lindskog (lindskog AT kth.se)	Contact person Prof. Pierre-Antoine Absil (PA.Absil AT uclouvain.be)

## Signatures:

Date:	Date:
For KTH	For UCL
Per Berglund Vice Dean of Faculty KTH	Prof. Vincent Blondel Dean, Louvain School of Engineering UCL
Leif Kari Dean, School of Engineering Sciences KTH	Prof. Marc Lobelle, UCL Cluster Dual Masters coordinator
	Prof. Pierre-Antoine Absil, Academic responsible for program

This page is intentionally left blank

*Plan for Cluster Dual Degree (120 ECTS)*

### **KTH/Department of Mathematics**

(lindskog AT kth.se)

**Master's Degree in Applied and Computational Mathematics**

2 year program, language of instruction: English

#### **Admission criteria**

##### ***Basic eligibility requirements***

A completed Bachelor's degree, equivalent to a Swedish Bachelor's degree (180 university credits), from a university recognized by government or accredited by other recognized organization. A good knowledge of written and spoken English. Applicants must provide proof of their proficiency in English, see <http://www.kth.se/> for details.

##### ***Specific eligibility requirements***

The prerequisites for the Master's program in Applied and Computational Mathematics is a Swedish or foreign degree equivalent to Bachelor of Science of 180 university credits, with at least 45 university credits in mathematics. The students are required to have documented knowledge corresponding to basic university courses in analysis in one and several variables, linear algebra, numerical analysis, differential equations and transforms, and mathematical statistics. The students are also required to have knowledge and training in basic programming.

##### ***Selection process***

The selection process is based on a total evaluation of the following criteria: university, grades in courses relevant to the program: mathematics in a wide sense, and motivation letter. In addition, English language skills above the minimum requirements will give a higher overall evaluation score. Complete information on the eligibility requirements can be found in the local admission policy of KTH.

#### **Specific requirements for second year students**

Second year students entering KTH must satisfy first year's admission requirements. Additionally, students must have obtained the ECTS of courses equivalent to the mandatory courses of the KTH program or propose a second year program fulfilling the KTH degree requirements. The student must have selected a specialization in agreement with the program coordinator at KTH.

#### **KTH degree requirements**

- the minimum requirements for conferring KTH degree are the following:
  - o **at least 55 ECTS** in KTH, which do not necessarily include the thesis.
- in practice first year or second year students at KTH are possible.
- thesis: 30 ECTS
- The common requirements for cluster dual degrees apply (see **Cooperation Agreement on Cluster Dual Masters**).

## **UCL/School of Engineering**

(Francois.Glineur AT uclouvain.be, absil AT inma.ucl.ac.be)

**Master of Science in Mathematical Engineering** (Master : ingénieur civil en mathématiques appliquées)

Language of instruction: In the suggested schedule of studies given below, [En] means that the course is in English, [Fr-En] means that the course is in French but accessible to English speakers (course notes and exams available in English), and [Fr] means that the course is in French. A course of studies fully in English is available; see below.

### **Admission criteria**

#### **Basic eligibility requirements**

A Bachelor of science in engineering (180 ECTS) from a CLUSTER institution. Other applications are handled on a case-by-case basis.

#### **Specific eligibility requirements**

A reasonable bachelor-level background is expected in the following three domains: optimization; systems and control; computational mathematics (numerical analysis). Otherwise, the student is expected to make up for the missing background by taking adequate introductory courses. The student must have developed methodological and practical skills.

#### **Selection process**

Students are required to lodge an application with the academic commission of the Master in Applied Mathematics, including a detailed curriculum vitae (year-by-year list of courses and grades). The commission proposes a course of studies adapted to the student's situation.

Complete information on the eligibility requirements can be found at <http://www.uclouvain.be/en-381355.html>.

### **Specific requirements for second year students**

Second year students entering UCL must satisfy first year's admission requirements.

Additionally, students must have obtained the ECTS of courses equivalent to the mandatory courses of the UCL program or propose a second year program fulfilling the UCL degree requirements. The student should have chosen a master thesis topic in agreement with one supervisor at UCL. The list of proposed topics is made available during the spring semester of the first master year.

#### **UCL degree requirements**

- the minimum requirements for conferring the above mentioned UCL degrees are the following:
  - o **at least 55 ECTS** in UCL, which do not necessarily include the master thesis.
- in practice first year or second year at UCL are possible.
- Master thesis + seminar: 30 ECTS
- The common requirements for cluster dual degrees apply (see **Cooperation Agreement on Cluster Dual Masters**).

## **Suggested Schedule of Studies**

### **List by topic**

#### *Mandatory:*

- [SF2520](#) (7.5 ECTS p1-2) Applied numerical methods **or** [LINMA2171](#) (5 ECTS q1) [Fr-En] Numerical analysis: approximation, interpolation, integration **and** [LINMA1170](#) (5 ECTS q1) [Fr] Numerical analysis
- [SF2812](#) (7.5 ECTS p3) Applied linear optimization **or** [LINMA2471](#) (5 ECTS q1) [Fr-En] Optimization models and methods
- [SF2832](#) (7.5 ECTS p2) Mathematical systems theory **or** [LINMA2370](#) (5 ECTS q1) [Fr-En] Modelling and analysis of dynamical systems **and** [LINMA1510](#) (5 ECTS q2) [Fr] Linear control
- [SF2863](#) (7.5 ECTS p2) Systems engineering **or** [LINMA2470](#) (5 ECTS q2) [Fr-En] Discrete stochastic models
- [SF2940](#) (7.5 ECTS p1) Probability theory **or** [LINMA1731](#) (5 ECTS q2) [En] Stochastic processes: estimation and prediction
- [AK2036](#) (7.5 ECTS p1 also given p2, p3, p4) Theory and methodology of science with applications **or** [LSTAT2040](#) (4 ECTS q2) [Fr] Multivariate probabilities and statistics **and** [LFSAB1801](#) (3 ECTS q2) [Fr] Critical history of science and technology
- Master thesis (30 ECTS)

#### *Elective courses:*

- 30 credits to be chosen among KTH's three specializations (<http://www.kth.se/en/studies/programmes/master/programmes/physics-mathematics/applied-and-computational-mathematics>) and UCL's list of recommended courses (<http://www.uclouvain.be/en-prog-map2m-lmap229o>)
- Additional credits may be chosen according to each program's rules in order to reach a total of 120 credits for the master

UCL will make available to KTH an updated list of recommended elective courses that are in English ([En]) or accessible to English speakers ([Fr-En]). As of 2013, the list stands as follows:

- [LINMA2120](#) [En] Applied mathematics research seminar
- [LINMA2360](#) [Fr-En] Project in mathematical engineering
- [LINMA2415](#) [En] Quantitative energy economics
- [LINMA2450](#) [En] Combinatorial optimization
- [LINMA2460](#) [En] Optimization: nonlinear programming
- [LINMA2491](#) [En] Operational research
- [LINMA2361](#) [Fr-En] Nonlinear systems
- [LINMA2671](#) [Fr-En] Automatic: theory and implementation
- [LINMA2875](#) [En] System identification
- [LELEC2870](#) [En] Machine learning: regression, dimensionality reduction and data visualization
- [LINGI2262](#) [En] Machine learning: classification and evaluation
- [LMECA2732](#) [En] Introduction to robotics
- [LINMA2111](#) [En] Discrete mathematics II: Algorithms and complexity
- [LINMA2472](#) [Fr-En] Advanced topics in discrete mathematics
- [LINMA2345](#) [En] Game theory
- [LINMA2710](#) [En] Numerical algorithms
- [LMAT2450](#) [En] Cryptography

## Annex 1 to the agreement on CLUSTER Dual Masters between UCL and KTH

- [LINGI2348](#) [En] Information theory and coding
- [LELEC2885](#) [En] Image processing and computer vision
- [LELEC2900](#) [En] Signal processing
- [LGBIO2050](#) [En] Medical imaging
- [LINGI2347](#) [En] Computer system security
- [LELEC2760](#) [En] Secure electronic circuits and systems
- [LINGI2144](#) [En] Secured systems engineering
- [LELEC2620](#) [En] Modeling and implementation of analog and mixed analog/digital circuits and systems on chip
- [LINGI2141](#) [En] Computer networks: information transfer
- [LSTAT2130](#) [Fr-En] Introduction to Bayesian statistics
- [LSTAT2350](#) [Fr-En] Data mining
- [LECON2011](#) [En] Interdependencies and strategic behavior

### **A typical course of studies: First year at KTH, second year at UCL**

This course of studies is fully in English, provided that the elective courses at UCL are chosen among the “[En]” courses listed above.

#### **KTH:**

- [SF2520](#) (7.5 ECTS p1-2) Applied numerical methods
- [SF2812](#) (7.5 ECTS p3) Applied linear optimization
- [SF2832](#) (7.5 ECTS p2) Mathematical systems theory
- [SF2863](#) (7.5 ECTS p2) Systems engineering
- [SF2940](#) (7.5 ECTS p1) Probability theory
- [AK2036](#) (7.5 ECTS p1 also given p2, p3, p4) Theory and methodology of science with applications
- Elective courses (to reach a total of at least 60 credits for year 1)

#### **UCL:**

- Elective courses (at least 30 credits)
- Master thesis (and seminar)

### **A typical course of studies: First year at UCL, second year at KTH**

This course of studies is fully accessible to English speakers, provided that the elective courses at UCL are chosen in the list above.

#### **UCL:**

- [LINMA2471](#) (5 ECTS q1) [Fr-En] Optimization models and methods
- [LINMA2470](#) (5 ECTS q2) [Fr-En] Discrete stochastic models
- [LINMA1731](#) (5 ECTS q2) [En] Stochastic processes: estimation and prediction
- Elective courses (to reach a total of at least 60 credits for year 1)

#### **KTH:**

- [SF2520](#) (7.5 ECTS p1-2) Applied numerical methods
- [SF2832](#) (7.5 ECTS p2) Mathematical systems theory
- [AK2036](#) (7.5 ECTS p1 also given p2, p3, p4) Theory and methodology of science with applications
- Elective courses (at least 7.5 credits)
- Master thesis (and seminar)

Annex 1 to the agreement on CLUSTER Dual Masters between UCL and KTH

**KTH/Department of mathematics**

Detailed information on the courses can be found in our web site. Please, click on the selected subject at <http://www.math.kth.se/>

**UCL/Louvain school of engineering**

Detailed information on the courses in the field of Applied Mathematics can be found in our web site:

<http://www.uclouvain.be/en-prog-map2m>

Courses on French as a foreign language of 3 to 8 ECTS are available. However they may only be accounted for 3 ECTS as elective courses in the program. Other elective language courses are also available and accountable for 3 ECTS.

This Annex has been signed in two originals in English, of which each institution has taken one.