



Open your mind. LUT.  
Lappeenranta University of Technology

Lappeenrannan teknillinen yliopisto  
Lappeenranta University of Technology

Self-Assessment Report for International Accreditation  
– Bachelor's and Master's degree programmes  
in Chemical Engineering

Editors: Ilkka Turunen, Ritva Tuunila, Maaret Paakkunainen, Harri Niemi, Annikka Nurkka

Lappeenrannan teknillinen yliopisto  
Hallinnon julkaisuja 186

## **Self-Assessment Report for International Accreditation – Bachelor's and Master's degree programmes in Chemical Engineering**

Editors: Ilkka Turunen, Ritva Tuunila, Harri Niemi, Maaret  
Paakkunainen, Annikka Nurkka

ISBN 978-952-265-273-7 (PDF)  
ISSN 0782-3770  
Lappeenranta 2012

## CONTENTS

<b>1</b>	<b>Formal Data</b>	<b>3</b>
<b>1.1</b>	<b>Name and contact details</b>	<b>3</b>
<b>1.2</b>	<b>Classification</b>	<b>3</b>
<b>1.3</b>	<b>Classification as consecutive – non consecutive – further education</b>	<b>3</b>
<b>1.4</b>	<b>Degrees to be awarded</b>	<b>3</b>
<b>1.5</b>	<b>Standard period of study</b>	<b>3</b>
<b>1.6</b>	<b>Commencement of degree programme</b>	<b>3</b>
<b>1.7</b>	<b>Fees / charges</b>	<b>4</b>
<b>2</b>	<b>Objectives and Demands – Reasons for Establishing the Programmes</b>	<b>4</b>
<b>2.1</b>	<b>Educational Objects and Competency Profile</b>	<b>4</b>
2.1.1	<i>Overall objectives of the applicant Bachelor's and Master's degree programmes</i>	4
2.1.2	<i>Description of the learning outcomes to be attained during the course of study</i>	5
2.1.3	<i>Objectives of individual modules</i>	5
2.1.4	<i>Professional focus</i>	5
2.1.5	<i>Target enrolment / staff-student ratio</i>	5
<b>2.2</b>	<b>Demand</b>	<b>6</b>
2.2.1	<i>Target group</i>	6
2.2.2	<i>Placement of graduates on the labour market</i>	6
2.2.3	<i>Demand from industry</i>	6
<b>3</b>	<b>Educational Process</b>	<b>7</b>
<b>3.1</b>	<b>Entry and Admission Requirements</b>	<b>7</b>
3.1.1	<i>Entry requirements for Bachelor's degree programme</i>	7
3.1.2	<i>General / specialized variant of the higher education entrance qualification, qualification for entrance to a university of applied sciences, relevant professional training</i>	7
3.1.3	<i>Industrial placements, work experience</i>	8
3.1.4	<i>Foreign language skills, Finnish language skills</i>	8
3.1.5	<i>Aptitude tests</i>	8
3.1.6	<i>Entry requirements for Master's Degree Programme (selection criteria)</i>	8
3.1.7	<i>Transfers from / to the conventional system of qualification</i>	8
<b>3.2</b>	<b>Course of Study</b>	<b>9</b>
3.2.1	<i>Curricular content</i>	9
3.2.2	<i>Orientation – national / international</i>	9
3.2.3	<i>Didactic concept / programme type</i>	9
3.2.4	<i>Structure</i>	10
3.2.5	<i>Workload / number of class hours per week during semester and credit points, face-to-face hours, independent study</i>	11
3.2.6	<i>Credit point system</i>	11
3.2.7	<i>Examinations</i>	12
3.2.8	<i>Degree / examination regulations</i>	12
3.2.9	<i>Diploma supplement</i>	13
<b>4</b>	<b>Resources</b>	<b>13</b>
<b>4.1</b>	<b>Institution and Context</b>	<b>13</b>
4.1.1	<i>Description of the University</i>	13
4.1.2	<i>Committees responsible for teaching in the degree programmes applying accreditation</i>	14
4.1.3	<i>Main areas of research, R&amp;D activities including an explanation of their relationship to the degree programmes</i>	14
4.1.4	<i>Degree programmes and degrees related to the degree programme</i>	15

4.1.5	<i>Areas of specialization in teaching (and research)</i>	15
<b>4.2</b>	<b>Partnerships – Cooperation Related to the Degree Programme</b>	<b>15</b>
4.2.1	<i>Cooperation within the university</i>	15
4.2.2	<i>External cooperation with institutions of higher education / other institutions</i>	15
<b>4.3</b>	<b>Participating Staff</b>	<b>18</b>
4.3.1	<i>Composition</i>	18
4.3.2	<i>Supervision</i>	18
4.3.3	<i>Relevant professional development measures / opportunities</i>	19
<b>4.4</b>	<b>Financial and Physical Resources</b>	<b>20</b>
4.4.1	<i>Human resources</i>	20
4.4.2	<i>Physical resources</i>	20
4.4.3	<i>Investment funds</i>	20
4.4.4	<i>Investment funds for major equipment purchased over the past three years or about to be purchased</i>	20
4.4.5	<i>Premises (refers to the whole university)</i>	21
<b>4.5</b>	<b>Support for Teaching and Study</b>	<b>21</b>
4.5.1	<i>Computer facilities</i>	21
4.5.1.1	<i>Computer equipment</i>	21
4.5.1.2	<i>Student supervision / qualifications of the supervisory staff</i>	21
4.5.1.3	<i>Access, number of computers / pools, opening hours, etc</i>	21
4.5.1.4	<i>Description of the tasks performed by the students on PCs</i>	22
4.5.1.5	<i>Restrictions / hindrances</i>	22
4.5.2	<i>Library / Literature / Media facilities</i>	22
4.5.2.1	<i>Inventory</i>	22
4.5.2.2	<i>Other media</i>	22
4.5.2.3	<i>Procurement / responsibility, coordination, etc</i>	22
4.5.2.4	<i>Student access / electronic access</i>	22
4.5.2.5	<i>Staff qualifications</i>	23
4.5.2.6	<i>Workplaces for students</i>	23
4.5.2.7	<i>Restrictions / hindrances</i>	23
4.5.3	<i>Laboratory facilities / equipment</i>	23
4.5.3.1	<i>Equipment and technical level</i>	23
4.5.3.2	<i>Student supervision / qualifications of the supervisory staff</i>	23
4.5.3.3	<i>Access, workplaces, opening hours</i>	23
4.5.3.4	<i>Restrictions / hindrances</i>	23
4.5.4	<i>Academic guidance measures for prospective and existing students</i>	23
<b>5</b>	<b>Attainment of Objectives</b>	<b>25</b>
<b>5.1</b>	<b>Data and statistics on the success of the degree programme</b>	<b>25</b>
<b>5.2</b>	<b>Overview and assessment of external evaluation outcomes</b>	<b>25</b>
<b>5.3</b>	<b>Overview and assessment of internal evaluation outcomes</b>	<b>26</b>
<b>5.4</b>	<b>Number of students commencing each degree programme</b>	<b>27</b>
<b>5.5</b>	<b>Number of students per course semester and degree programme</b>	<b>27</b>
<b>5.6</b>	<b>Graduates</b>	<b>28</b>
<b>5.7</b>	<b>Student/staff- ratio</b>	<b>28</b>
<b>6</b>	<b>Quality Assurance Measures</b>	<b>28</b>
<b>6.1</b>	<b>Evaluation during the degree programme</b>	<b>29</b>
<b>6.2</b>	<b>Evaluation of the success of the degree programme</b>	<b>29</b>
<b>6.3</b>	<b>Further development of the degree programme – ongoing improvement</b>	<b>30</b>
	<b>ENCLOSURE LIST</b>	<b>31</b>

## **1 Formal Data**

### **1.1 Name and contact details**

Kemiantekniikan koulutusohjelma, tekniikan kandidaatin tutkinto.  
Kemiantekniikan koulutusohjelma, diplomi-insinöörin tutkinto.

Bachelor's Degree Programme in Chemical Engineering.  
Master's Degree Programme in Chemical Engineering.

Language of instruction: Finnish (and a small number of modules in English)

Contact person: Prof. Ilkka Turunen

[ilkka.turunen@lut.fi](mailto:ilkka.turunen@lut.fi)

+358-40 569 2450

+358-5 621 2199 (fax)

[www.lut.fi](http://www.lut.fi)

### **1.2 Classification**

More research-oriented.

### **1.3 Classification as consecutive – non-consecutive – further education**

Consecutive

### **1.4 Degrees to be awarded**

Tekniikan kandidaatti, Bachelor of Science in Technology  
Diplomi-insinööri, Master of Science in Technology

The above degrees, and the Finnish universities that can award them, are defined in the Universities Act (558/2009) and in the Government Decree on University Degrees (794/2004).

### **1.5 Standard period of study**

The extent of studies required for a lower university degree (Bachelor's degree) is 180 credits and for the higher university degree (Master's degree) 120 credits. The university must arrange the education in such a manner that to students are able to complete the lower degree in three years, and the higher degree in two years of full-time study (Government Decree on University Degrees 794/2004).

The programmes described here are planned for full-time studies.

### **1.6 Commencement of degree programme**

The academic year of the university starts on 1 August and ends on 31 July. It is divided into two semesters. The autumn semester and spring semester each include two periods of instruction lasting seven weeks each.

Modules can last from one to four periods. However, the university also offers some of them as intensive modules. In those cases the length of the modules varies. Most modules are offered every

year, but a few o (less than 3 %) are taught every second year. Module details are given in the module descriptions available in the study guide (Enclosure 5 Module Handbook).

As a result of implementation of the Bologna Process in Finnish universities, the present degree structures have been effective since 2005. The transition period to the new curricula (until 31.7.2010) has naturally had an effect on various statistical data, which has to be taken into account in their interpretation.

## 1.7 Fees / charges

According to the Universities Act in Finland, education leading to a university degree and entrance examinations relating to student admission shall be free of charge for the student.

The students of Lappeenranta University of Technology must register each academic year as attending or non-attending. Each student who wishes to take part in lectures, assignments, examinations or other forms of teaching must register as attending and pay the Student Union membership fee of 103 €/a. This fee covers, for instance, the health care of students.

## 2 Objectives and Demands – Reasons for Establishing the Programmes

### 2.1 Educational Objectives and Competency Profile

#### 2.1.1 *Overall objectives of the applicant Bachelor's and Master's degree programmes*

The greatest demand for the knowledge, skills and competencies obtained in both programmes are in the field of process industry, especially in the chemical, pulp and paper and metallurgical industries, as well as in the manufacture of process equipment. In addition, chemical engineering knowledge is more and more needed also in connection with other activities in society, e.g. in other branches of industry and public administration, education and trade.

The objective of these programmes is to give basic knowledge, skills and competencies required in R&D, process and equipment design, process operation, quality control, utilization of waste and by-products and promotion of safety, environmental protection and health. Another objective is to prepare students for continuation of their studies to higher degrees in chemical engineering or chemical technology.

In general the Bachelor's degree programme provides students with fundamental knowledge and skills in the field of natural sciences and chemical engineering. Programme also provides students with a capacity of basic scientific thinking and working methods.

The Master's degree programme provides students with a good knowledge of their major subject and fundamental knowledge of their minor subject, and ability to think and work on scientific manner. The programme shall also provide students with good communication, presentation, language, cultural, project and team work skills.

The educational objectives in the programmes can be classified into six groups in the following way. The graduates have to acquire deep **knowledge and understanding (a)** in mathematics, relevant natural sciences and engineering disciplines. They have also to learn skills needed in **knowledge management (b)**, **engineering analysis and investigations (c)**, **engineering design and development (d)**, and **engineering practice (e)**. Further, the graduates have to acquire **transferable skills (f)** which are more or less common for all engineering disciplines.

The goals of Bachelor's and Master's degree programmes are described separately, in the form of learning outcomes, in Enclosures 1a and 1b.

### 2.1.2 *Description of the learning outcomes to be attained during the course of study*

The learning outcomes are described in Enclosures 1a and 1b, Table 2.1. Teachers, students and representatives of employers have participated in the formulation of these outcomes (see Enclosure 2, Minutes of a meeting of the teaching committee).

### 2.1.3 *Objectives of individual modules*

The modules are listed in Table 2.3.1., Enclosure 3. The curricular categories of both the Bachelor's and Master's Programme are shown in Table 2.3.2., Enclosure 3.

The contribution of the modules to the different learning outcomes is defined in Tables 2.2. a,b,c,d,e and f, Enclosures 1a and 1b.

### 2.1.4 *Professional focus*

Main target fields of industry: Process industry, especially chemical, pulp and paper and metallurgical industry.

Main professional fields: R&D, process and equipment design, process operation, quality control, utilization of wastes and by-products, promotion of safety, environmental protection and health.

Strong expertise: separation technology, innovative process development and design.

Most Master's theses and some of the assignments (e.g. project works) are done in co-operation with industrial companies. This helps students to understand the professional environment and requirements of working life. In addition, many students participate in research projects which are carried out together with industry.

Practical training is included in both Bachelor's degree (2 ECTU) and Master's degree (4 ECTU).

### 2.1.5 *Target enrolment / staff-student ratio*

The current target number of students accepted on the Bachelor's degree programme is 40. The figures for 2009 and 2010 were 42 and 40 respectively. The same students are assumed to continue onto the Master's Programme.

The teaching staff / student – ratio has been the following:

2005	2006	2007	2008	2009
4,4	4,2	4,3	3,9	4,9

The figures include students and teachers of all the degree programmes of the Department of Chemical Engineering. The figure is higher for the Bachelor's degree programme, and lower for the Master's degree programme lower.

## 2.2 **Demand**



### 2.2.1 *Target group*

The main target group for the Bachelor's degree programme is formed from students who have completed the Finnish matriculation examination.

The main target group for the Master's degree programme is formed from students who have the degree of Bachelor of Science from a Finnish university.

### 2.2.2 *Placement of graduates in the labour market*

Graduates from the Master's degree programme are mainly employed in process industry (especially the chemical, metallurgical and pulp and paper industries). According to a survey by Lappeenranta University of Technology, the employment rate of graduates from the Master's Degree Programme of Chemical Engineering was the following:

Graduation year	Employment percentage (5 years after graduation)
2003	92 %
2002	90 %
2001	80 %

Graduates from Bachelor's degree programme, who do not continue onto Master's programme, are employed in the same fields of industry as the Masters, but in less demanding tasks. Reliable employment percentages for bachelors are not yet available. Industry is not eager to employ Bachelors but expects them to continue to Master's degree.

Companies which have employed many of graduates from LUT include e.g. Kemira, Neste Oil, Fermion, Orion from chemical industry, Outotec and Norilsk Nickel from metallurgical industry and UPM-Kymmene, Sora-Enso, Metso Paper, Andritz and Pöyry from production, equipment manufacturing and design in pulp and paper industry.

### 2.2.3 *Demand from industry*

The three most important industrial sectors, the chemical industry, the metallurgical industry and the pulp and paper industry are discussed separately below.

According to Cefic, growth can be expected in the European chemical industry:

"We anticipate output in the chemical industry to grow by 9.5% in 2010, and our expectations for 2011 point to a growth of 2% compared to 2010", says Dr. Hubert Mandery, Director General of Cefic, the European Chemical Industry Council. Similar growth can be expected also in Finland. According to the Federation of Finnish Chemical Industry, the number of employees in the field has remained stable over the last few years. Ageing of the workforce will be a key challenge for the industry in the future.

After recession, the metallurgical industry in Finland is again on growing trend. Traditionally, certain companies in this field (especially Outotec Oy) have been a potential employer for graduates from Lappeenranta, and it is expected that they will continue in this role.

The pulp and paper industry has had difficulties worldwide, because of production being transferred to countries where raw material and labour are cheaper. Companies in this field are making strategic changes and new production processes, e.g. biorefineries, are being developed. In such installations, biofuels, energy and chemicals from wood are produced in addition to pulp and paper. Lappeenranta

University of Technology has employed a new professor of “Process Technology of Biomaterials” to be able to teach students in this topic.

### **3 Educational Process**

#### **3.1 Entry and Admission Requirements**

##### *3.1.1 Entry requirements for the Bachelor’s degree programme*

Student selection for the Bachelor’s degree is mainly organized by a joint universities’ application system, DIA (Joint-Application for Studies of Bachelor and Master of Science in Technology). This joint application system is common to seven technical universities in Finland. It is coordinated by a joint application committee. The process enables an applicant to apply for five degree programmes in order of preference in several Technical Universities using the same application form and entrance examinations.

Prospective students applying for the Bachelor’s degree include:

- Applicants who have completed the Finnish matriculation examination.
- Applicants who have completed the EB, IB (European and International Baccalaureate) or Reifeprüfung (from die Deutsche Schule, Helsinki) degree.
- Applicants who will complete the EB, IB or Reifeprüfung degree either in Finland or abroad during the application year. These applicants must include their degree certificate or a certificate of participation in the respective examination from their school with their application form.
- Applicants who are not upper secondary school graduates but who have completed a polytechnic higher vocational degree, vocational polytechnic degree or at least a three-year vocational degree.
- Applicants who have not completed upper secondary education in Finland are eligible to apply for Bachelor degree courses if they are eligible for to study at a university in their own country.

Applicants can be selected in DIA based on their success in the Finnish matriculation examination or by their success in the matriculation examination and the entrance examinations or only their success in the entrance examinations. The entrance examinations are organized by the joint application procedure. The entrance examination is based on the Finnish upper secondary school curriculum in mathematics, physics and chemistry. Prospective students must pass the entrance examination to be selected even if there are fewer applicants than places available. This guarantees a minimum knowledge level in science of all selected students.

To be selected based on success in the matriculation examination the prospective student must have at least grade C in physics or chemistry and have passed the advanced course in mathematics or he/she must have at least M in the advanced course in mathematics. Up to 40 % of the applicants accepted onto the Bachelor’s degree programme can be selected on the basis of their success in the matriculation examination. DIA organizes also this selection. The results are told to the applicants before the entrance examinations. Students accepted on the basis of their success in the matriculation examination are not allowed to participate in the entrance examinations.

##### *3.1.2 General / specialized variant of the higher education entrance qualification, qualification for entrance to a university of applied sciences, relevant professional training*

There are two specialized variants of the entrance procedure for the Bachelor’s degree programme:

- Studies in the Open University (after performing 30 ECTU including 16/19 ECTU mathematics and 5 ECTU physics, average grade at least 2.0)
- Prospective students who have performed forest industry line METELI in upper secondary school

### 3.1.3 *Industrial placements, work experience*

Students applying for the Bachelor's degree programme are not required to have any previous work experience or industrial placements. Work experience and industrial placements are not evaluated in the application process.

### 3.1.4 *Foreign language skills, Finnish language skills*

Bachelor's degrees are fully taught in Finnish. Native Finnish applicants are assumed to have sufficient skill in the Finnish language. Applicants who have completed their compulsory education in a language other than Finnish must provide a certificate of their language proficiency in the Finnish language. Applicants whose mother tongue is Finnish are exempted from this requirement. Sufficient proof of language proficiency can be demonstrated by completing the National Certificate of Language Proficiency test at level 4 or above (scale: level 1 – beginner, level 6 – advanced)).

### 3.1.5 *Aptitude tests*

The entrance examination contains mathematics, physics and chemistry as aptitude tests to engineering education.

### 3.1.6 *Entry requirements for Master's degree programme (selection criteria)*

All students admitted to the Bachelor's degree programme are also admitted to the Master's degree programme (as in all universities in Finland). The master's thesis project cannot be commenced (the topic of the thesis cannot be applied for) before completing the Bachelor's degree.

Persons, who have completed a Bachelor of Engineering/B.Sc. in Science (Technology) degree in a Finnish University in the relevant field of study or in a closely related field, can apply to the Master's degree programme. The Head of the degree programme makes the decisions regarding admission of the applicant and any possible complementary (bridging) studies required.

Persons, who have completed a M.Sc. degree in a Finnish university in chemistry or closely related field, can apply for the Master's degree programme. The Head of the degree programme makes decisions regarding admission of the applicant and any complementary (bridging) studies required.

Applicants with a Bachelor's degree from Finnish Universities of Applied Science (Polytechnics) are not eligible to apply for this degree programme. A separate programme, which is not included in this accreditation process, exists for such applicants.

### 3.1.7 *Transfers from / to the conventional system of qualification*

Recognition and assessment of prior learning is in use. If student performs studies in another university or educational institute in Finland or abroad, he/she must request that the Head of the degree programme to credit the studies done elsewhere.

A student can receive credit for and replace study modules also by knowledge gained otherwise. Knowledge can be proven by oral or written examination. Also portfolios are used as a measure to validate the prior gained knowledge.

## **3.2 Course of Study**

### *3.2.1 Curricular content*

Tables 2.3.1 and 2.3.2 in Enclosure 3 show an overview of the curricular content of the Bachelor's and Master's degree programmes. Table 2.3.1 is a list of modules which can be included as obligatory or elective studies in the degree programme. The credit points of each module are divided into the following categories: FMN (fundamentals of mathematics and natural sciences), SF (subject specific content), AS (advanced subject specific content), NT (non-technical content including principles of business management).

The structures of the degree programmes including the contents of general studies, major and minor subjects as well as elective studies, are discussed in Chapter 3.2.4.

Examples of the structures of the Degree Programmes are given in Enclosures 17 and 18.

### *3.2.2 Orientation – national / international*

The Bachelor's and Master's degree programmes are aimed at national students, and teaching is mainly given in Finnish language. However, some modules taught in English, can be included in a student's studies. Obligatory studies of foreign languages are included in the degree programmes, 4 ECTU for both Bachelor's and Master's degrees.

Studying abroad is not obligatory, but the University encourages students for that. LUT takes part in a number of international student exchange programmes (Erasmus, Nordtek, ISEP etc.), and has many bilateral student exchange agreements.

Studies in foreign universities can be included in the student's degree in LUT, if they are suitable to compensate studies in the LUT degree programme. In most cases, students have to present a study plan before starting studies abroad, if he/she intends to apply recognition and compensation of studies done abroad.

### *3.2.3 Didactic concept / programme type*

Both the Bachelor's and Master's degree programmes are full-time, on-campus programmes.

The teaching methods consist of lectures, classroom and laboratory exercises, supervised assignments (individual or team work), projects and seminars.

A small part (< 5 %) of the education is realized as e-learning. Project assignments in plant design are carried out as project tasks with topics given by industry. Representatives from companies participate in supervision and project meetings. Some of the topics of exercises originate from research projects of the department.

Pedagogic advice to teachers is given in the "LUT Teacher's Quality Manual", Encl. 7.

### 3.2.4 Structure

180 ECTU are required for the Degree of Bachelor of Science. National regulations demand that the university has to arrange the education in such a way that it is possible to attain the degree in three full academic years. The structure of the Bachelor's degree programme is described in *the University Regulations on Education and the Completion of Studies* (Section 31, Enclosure 4).

The Bachelor's degree comprises the following classes of studies:

- |                     |              |
|---------------------|--------------|
| 1. General studies  | min. 70 ECTU |
| 2. Major subject    | min. 40 ECTU |
| 3. Minor subject    | min. 20 ECTU |
| 4. Elective studies | min. 10 ECTU |

Foreign language and communication studies are included in General studies. The Bachelor Thesis including seminar (10 ECTU) is included in Major subject.

120 ECTU are required for the Degree of Master of Science. National regulations demand that the university has to arrange the education in such a way that the degree can be attained in two full academic years.

The structure of the Master's degree programme is described in *the University Regulations on Education and the Completion of Studies* (Section 36, Enclosure 4).

The Master's degree comprises the following classes of studies:

- |                     |              |
|---------------------|--------------|
| 1. General studies  | min. 5 ECTU  |
| 2. Major subject    | min. 60 ECTU |
| 3. Minor subject    | min. 20 ECTU |
| 4. Elective studies | min. 10 ECTU |

Foreign language and communication studies are included in General studies. Master Thesis including seminar (30 ECTU) is included in the Major subject.

#### **Bachelor's Degree Programme in Chemical Engineering**

The Bachelor's degree programme takes three years, corresponds to 180 ECTU and leads to the degree of Bachelor of Science in Technology.

#### **Bachelor's degree in Chemical Engineering comprises the following studies**

A. General studies	107	ECTU
B. Major subject, B.Sc. Thesis included	40 (min.)	ECTU
C. Minor subject	20 (min.)	ECTU
D. Elective studies	6-11	ECTU
<i>Studies in total</i>	<i>180 (min.)</i>	<i>ECTU</i>

#### **Alternative major subjects**

- 1. Applied Chemistry**
- 2. Fiber and Paper Technology**
- 3. Process Engineering**

#### **Alternative minor subjects**

- 1. Applied Chemistry**
- 2. Fiber and Paper Technology**
- 3. Process Engineering**

### Master's Degree Programme in Chemical Engineering

The Master's degree programme takes two years, corresponds to 120 ECTU and leads to the degree of Master of Science in Technology.

#### Master's degree in Chemical Engineering comprises the following studies

A. General studies	21	ECTU
B. Major subject, M.Sc. Thesis included	60 (min.)	ECTU
C. Minor subject	20 (min.)	ECTU
D. Elective studies	16-18	ECTU
<i>Studies in total</i>	<i>120 (min.)</i>	<i>ECTU</i>

#### Alternative major subjects

1. Applied Chemistry
2. Fiber and Paper Technology
3. Process and Product Development
4. Unit Operations of Chemical Engineering

#### Alternative minor subjects

1. Applied Chemistry
2. Environmental and Safety Technology
3. Fiber and Paper Technology
4. Hydrometallurgy
5. Process and Equipment Design

The full structures of the degree programmes, including the modules to be studied in different subject groups are given in Enclosure 5 (Module Handbook).

A description of the contents of the major subjects in both the Bachelor's and Master's Degree Programmes is given in Encl. 19.

#### 3.2.5 *Workload / number of class hours per week during semester and credit points, face-to-face hours, independent study*

One semester is half of an academic year, which starts at the end of August/in the beginning of September, and ends in the middle of May. Two teaching periods of 7 weeks each are included in a semester. Three examination periods of ca. 1 week each are arranged, one just before the semester, one just after the semester and one between the teaching periods. Examinations are also arranged during the teaching periods.

The average workload per semester is ca. 800 hours, including face-to-face tuition, individual studying and preparation for and sitting of examinations. One ECTU equals to 26 hours of work.

The workloads for each semester in ECTU are given in Enclosure 6, Table 3.1 for the Bachelor's degree programme, and Tables 3.2a and 3.2b for the Master's degree programme.

#### 3.2.6 *Credit point system*

The basic unit of the studies is ECTU (European Credit Transfer Unit). A module is scored by the workload required to pass it. 1600 hours on average, corresponding to 60 ECTU, are required to complete the studies of one academic year.

One ECTU equals 26 hours workload, including face-to-face tuition, individual studying, as well as preparation and sitting the examinations.

Industrial training of 2 and 4 ECTU is required for the Bachelor and Master degrees, respectively. For training, one ECTU equals two week's working as an employee. The employment contract has to be a duration at least 15 days.

Studies completed in other universities or learning institutions can be included in the degree. This requires an approved application. Decisions on acceptance of studies done elsewhere are made by the Head of the degree programme.

More detailed description of the credit point system and inclusion of studies in other institutions are presented in *the University Regulations on Education and the Completion of Studies* (Enclosure 4).

### 3.2.7 *Examinations*

Examinations are arranged according to the valid curriculum. Additionally, teachers can arrange extra examinations. The examination and teaching periods are announced annually in the Module Handbook (Enclosure 5).

Generally, examinations are written ones. Oral or other types of examinations are exceptions. Usually individual assignments, reports and seminars are evaluated as pass/fail, but in some cases the same grading is used as for examinations (scale 1-5 or 0 for fail).

Modules are evaluated either on the scale: excellent (5), very good (4), good (3), very satisfactory (2), satisfactory (1) and fail (0), or alternatively: pass / fail. Additional instructions are given in *the University Regulations on Education and the Completion of Studies* (Section 71, Enclosure 4). The basis of the module evaluation (examination, assignment etc.) is explained in the course descriptions in the Module Handbook. Three examinations are arranged for each module. A student can participate in two of them.

The duration of a written examination is usually 3 hours, but sometimes 4 or 5 hours. In some cases separate theory and calculation examinations are arranged.

Compensation guidelines for disabled students are given in the LUT Teacher's Quality Manual, Enclosure 7.

LUT Chemical Engineering has developed a suggestive matrix for the assessment of Bachelor's and Master's thesis (Enclosure 8). Some teachers use similar matrices to evaluate their own modules.

A more detailed description of the rules regarding examinations, registration, evaluation and sanctions for unethical conduct are given in the Examination Regulations (Enclosure 9) and in *the University Regulations on Education and the Completion of Studies* (Enclosure 4).

Students have to participate in a maturity test in both the Bachelor's and Master's Programme. The purpose of the test is to check whether the student has sufficient understanding the topic of his/her thesis. In the connection of Bachelor's degree, the maturity test is used also to test requisite skill in the mother tongue.

### 3.2.8 *Degree / examination regulations*

To receive the Degree of Bachelor of Science from Lappeenranta University of Technology, at least 90 ECTU including the Bachelor Thesis, have to be gained in LUT (total degree 180 ECTU). For the Degree of Master of Science in Technology, the minimum is 70 ECTU, including the Master Thesis.

The Head of the degree programme makes decision regarding the modules included in the structure of the degree of an individual student, and approves any changes made to the student's study plan.

Detailed regulations of the Degree are given in *the University Regulations on Education and the Completion of Studies* (Enclosure 4).

### 3.2.9 *Diploma supplement*

A diploma supplement is attached to the degree certificate. It is targeted especially for use in an international context. It includes the information about the University, modules included in the degree, as well as the grades of the modules and the structure of the degree.

Examples of diploma supplements for both the Bachelor's and Master's degree are included as Enclosures 20 and 21.

## 4 **Resources**

### 4.1 **Institution and Context**

University education in Finland is governed by the Universities Act (558/2009) and the Government Decree on University Degrees (794/2004). The roles and responsibilities of the management of education are defined in the Administrative Regulations of the University. The educational goals are agreed upon annually in the negotiations between the University and the Ministry of Education and Culture. Attainment of the goals and targets agreed affect the financing granted to the University by the Ministry. Financing decisions are made on an annual basis.

#### 4.1.1 *Description of the University*

The university has three faculties: the Faculty of Technology, the Faculty of Technology Management, and the School of Business. The Department of Chemical Engineering belongs to the Faculty of Technology.

The University Board decides the strategic long-term educational goals and the degree programs provided by the University. The Board also decides the admission requirements and the number of new entrants accepted to the University's degree programmes. The Rector makes the decision on the approval of new entrants to the degree programmes. He/she also appoints, when necessary, a board of examiners to consider remedial requests concerning the study attainments.

The University has a Vice Rector responsible for teaching. In addition, each degree programme has an appointed head. The Vice Rector organizes a meeting between the heads of the degree programmes once in every two months to discuss about educational matters. The Vice Rector also leads the University's supervisory and development group for teaching appointed by the Rector. The goal of the group is to promote the internal cooperation within the University in the development of teaching and pedagogy.

Student representation in the University's administrative bodies is determined by the Universities Act and the Administrative regulations of the University. In accordance with the statutory representation requirements in administrative bodies, the students also have a representation in the University's and department's supervisory and development group for teaching. In addition, the students participate in



the development of teaching through the course evaluation carried out annually for each University study course, and through the teaching feedback enquiry organized by the Students' Union.

#### 4.1.2 *Committees responsible for teaching in the degree programmes applying accreditation*

The Faculty of Technology has a development group for teaching appointed by the Dean of the Faculty. The group has representation from each degree programme and also three student representatives.

The Faculty Council is responsible for supervising the quality of teaching. It also makes decisions pertaining to study plans and degree requirements. In addition, the Council makes proposals to the Rector concerning the entry requirements and the number of new students to be accepted on each programme.

The quantitative and qualitative goals of the Faculty are agreed on a yearly basis in the negotiations between the Faculty and the University. The University takes into account the results of the Faculty's operation in previous years and the Faculty's development needs when allocating the money received from the Ministry of Education and Culture.

The Faculty is responsible for the equipment needed for teaching and research. The Dean of the Faculty is responsible for the resources needed for teaching. The Dean also appoints the Heads of the Faculty's degree programmes. In addition, the Dean accepts the theses of the graduate students.

Heads of the degree programmes are responsible for producing, evaluating and developing the degree programmes. They approve the topics of the theses of graduate students. Each degree programme of the Faculty also has an advisory group to help the Head of the Programme.

The Degree Programme of Chemical Engineering has established "a Teaching Committee", consisting of teachers, students and representatives of industry. The purpose of the committee is to develop both the content and quality of education. The industrial representatives play an important role to guarantee that the contents of the programmes meet the changing requirements of professional life. The council meets once a year.

#### 4.1.3 *Main areas of research, R&D activities including an explanation of their relationship to the degree programmes*

The most important areas of expertise of the department include separation technology, process intensification and development and applied research in the chemical wood technology. Research groups, main research areas and their relationships to the degree programmes are presented in Enclosure 10 Table 4.1

To ensure the high quality of research, co-operation between various research groups on both national and international level has been made an integral part of the department's operations.

Growing interest in environmental protection and the need to develop new fuels has increased the amount of research conducted in these fields at the Department of Chemical Engineering which also follows LUT Strategy (see Enclosure 23).

The main areas in teaching are connected with the work of all research groups at the department. A direct link between research and teaching is ensured by the fact that all teachers are involved also in research and, on the other hand, all researches are giving their contribution to teaching.

#### 4.1.4 *Degree programmes and degrees related to the degree programme*

The department also has an international Master's Programme in Chemical and Process Engineering. From this, there is a separate branch of this programme for Russian double degree students. In addition, there is also a master's programme for Bachelor's of Engineering/Science, who have graduated from Polytechnics'. The department is participating in a national graduate school in chemical engineering, leading to the degree of D. Sc. (Tech.).

#### 4.1.5 *Areas of specialization in teaching (and research)*

The main focuses in teaching are the same areas as in research, which include different separation technologies, process development and intensification, and applied research in the wood processing technology.

## 4.2 **Partnerships – Cooperation Related to the Degree Programme**

### 4.2.1 *Cooperation within the university*

There is a cooperative institute, *Centre for Separation Technology (CST)* which consists of seven laboratories from the Department of Chemical Engineering together with 23 industrial companies and 9 research institutes. *CST* is active in research but also has some educational activities.

Co-operation between several degree programmes is seen for example in a shared module *Process and Product Innovations (10 ECTU)*. The aim of the module is for students to become acquainted with the generation of innovations and novel technology, studying typical methods and approaches, problems and their solutions via interdisciplinary, multinational project oriented teamwork.

The modules in the field of mathematics, physics and languages are produced by other departments and units of the university.

The degree programme of Chemical Engineering includes several modules from the other degree programmes of LUT and students may also apply to take a minor subject from some other programme. The student may also include any modules taught at LUT into his/her elective studies.

Department of Chemical Engineering cooperates actively within LUT in different educational development projects. Several teachers are participating in different groups inside LUT, for example in the Guidance and Development of Higher Education at LUT.

### 4.2.2 *External cooperation with institutions of higher education / other institutions*

Department of Chemical Engineering has external co-operation related to teaching with other institutions at three levels: student exchange, teacher exchange and international co-operation in the development of education. In addition, the department has several post-graduate level double degree agreements with foreign universities.

#### a) Student exchange

International student exchange and intake of degree students from foreign countries are strongly encouraged at LUT.

Student exchange is arranged by LUT International Services which supports the university's internationalization by developing and maintaining cooperation relationships and agreements with international universities and networks. International Services is in charge of organizing student exchange programmes and coordinating EU's education programmes within the university. The office of International Services advises international students who apply for admission to M. Sc. degree programmes taught English. International Services also provides advising and assistance for outgoing and incoming students with practical arrangements, offers an orientation programme, runs tutoring system for international students and helps with accommodation arrangements.

LUT has an extensive partner network all around the world. The network of over 150 higher education and research institutions forms an excellent basis for collaboration and mobility of students, teachers and researchers, as well as joint education and research projects.

Student mobility is facilitated by several study abroad programmes: the Erasmus exchange programme in Europe, Nordplus exchange within the Nordic countries and bilateral agreements with several partner universities overseas. LUT is or has been a partner in Erasmus actions, Leonardo projects, and as well in several other European projects such as Asia-Link, Tempus projects, COST actions, Networks of Excellence and research projects funded from the EU's Fifth, Sixth and Seventh Framework programmes in different sectors. LUT is also a member of the Cross-Border University project, a Finnish-Russian consortium of nine universities developing joint master's degree programmes. In addition, LUT has several double-degree agreements with Russian partner universities. LUT is also a member of ISEP network, the International Student Exchange Programme.

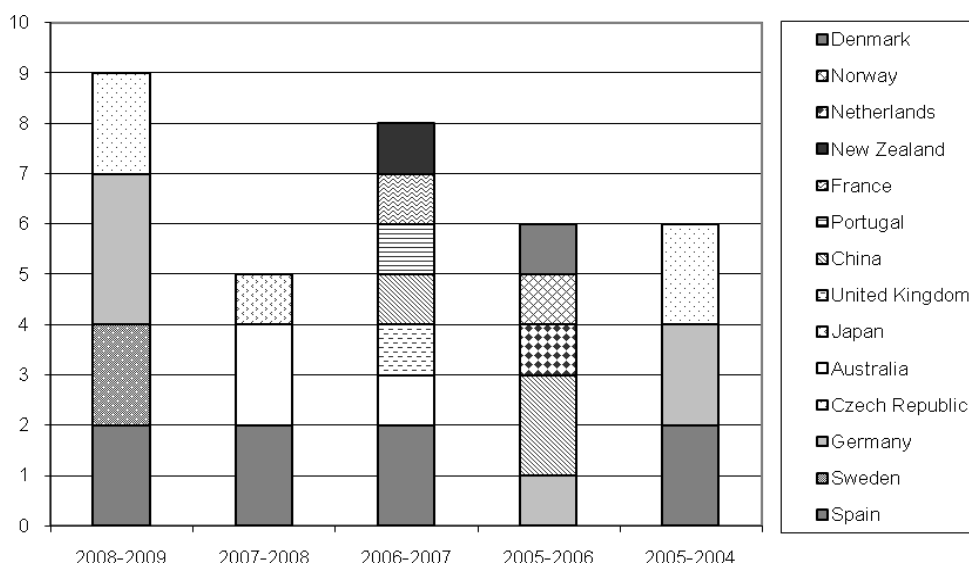


Figure 4.1. Exchange of LUT chemical engineering students during years 2004-2009.

#### b) Teacher exchange

LUT teachers can undertake short-term, 1-2 weeks, teaching assignments abroad within the framework of the Erasmus programme or within bilateral co-operation agreements. There are also possibilities for research exchange for teachers when the main focus during exchange period is research but the exchange also consist of some teaching lectures.

During the last five years teachers have visited for example in the University of Barcelona, the Jomo Kenyatta University of Agriculture and Technology in Nairobi, the "Babes-Bolyai" University, the Cluj-Napoka in Romania, the Brno University of Technology and in the Otto-von-Guericke University, Magdeburg. Total number of visits in international institutions in last five years is 9.

Several visiting lecturers from foreign universities come to LUT Chemical Engineering every year to give lectures.

c) International development of education

EFCE

European Federation of Chemical Engineering has promoted scientific collaboration and supported the work of engineers and scientists in 30 European countries. It represents today more than 100,000 chemical engineers in Europe and with its 20 Working Parties and 6 Sections it covers all areas of Chemical Engineering.

LUT is represented in three Working Parties: Education, Computer Aided Process Engineering and Process Intensification, and currently chairs two of them. LUT is the only member representing Finland in the Working Parties of Education and Process Intensification.

Although only the Working Party of Education is directly related to the development of higher education, also the other ones have occasional connections to teaching.

CHEMEPASS

The CHEMEPASS project was carried out by a consortium of 13 higher education institutions from 9 European countries and South Africa and financed for 3 years (2006 - 2009) by the **European Commission** within the **Action 4 of the Erasmus Mundus Programme**.

CHEMEPASS (Chemical Engineering Mobility Tools) was a project which developed innovative tools to promote international mobility and attractiveness in the European Chemical Engineering Higher Education. ([www.eceen-assoc.cope.fi](http://www.eceen-assoc.cope.fi))

CHEMEPASS tools are intended for:

- a) Evaluation and recognition of competences includes tools to improve the transparency of programmes and the evaluation of competences.
- b) Knowledge pedagogy includes tests of knowledge for training and evaluating of basic scientific knowledge.

LUT was an active member of CHEMEPASS involved for example in creating international database of questions for the students at the bachelor exit level focusing on a selection of core areas of Chemical Engineering. The test is included in a module Bachelor's thesis and seminar in Bachelor's degree programme in Chemical Engineering at LUT.

Within the CHEMEPASS LUT also contributed to the booklet entitled "**Meeting the Challenges in Chemical Engineering Higher Education: CHEMEPASS Quality Recommendations**".

EC2E2N (European Chemistry and Chemical Engineering Education Network)

This network brings together more than 100 actors in higher education (HE) in chemistry and chemical engineering. These include schools, universities, industrial companies, national chemical societies and accreditation bodies.

LUT Chemical Engineering is a member of EC2E2N management committee and is leading subproject "Improving Learning Outcomes".

### 4.3 Participating Staff

#### 4.3.1 Composition

A composition of teaching and research personnel in LUT is based on new four step system: Doctoral student, Post-doctoral researcher, Associate professor and Professor. Beside these, there still exist miscellaneous titles such as university lecture, researcher, project researcher, research assistant and research director. The number of staff involved in teaching is presented in Table 4.2. below.

Table 4.2. Staff

Position	Permanent positions	Total number of positions
Professors	4	9
Associate Professors	3	9
Post-doctoral researchers	0	4
University lecturers	0	1
Other academic staff (senior assistants, assistants and doctoral students)	0	27
Emeritus professors	0	2
Contract teachers	0	20
<b>Total academic staff</b>	<b>7</b>	<b>72</b>
Technical staff (laboratory engineers, technicians, laboratorians)	2	8
Other (secretaries, student advisers)	2	3
<b>Total non-academic staff</b>	<b>4</b>	<b>11</b>

More detailed descriptions of the expertise of staff participating in teaching are given in Staff Handbook (see Enclosure 11).

#### 4.3.2 Supervision

During teaching periods teaching takes place from 8 am to 8 pm from Monday to Friday including examinations. Office time at the university is from 8 am to 4 pm.

Teachers are responsible for the modules they teach, including supervision of the contents of their own modules. Teachers are available at the university mainly during office hours, but students may have guidance and individual supervision also out of these hours by fixing special appointment with the teacher.

General supervision of studies at the university and about the degree programme is given by the Head of Study Affairs of the faculty and by the study coordinator of the degree programme. In addition, study counseling is provided by the student adviser of the degree programme. The student adviser works part-time and helps students with practical study-related matters.

In addition, there are tutors at two levels: student tutors, who help first year students with practical matters and teacher tutors who help students with their personal study plans.

#### 4.3.3 *Relevant professional development measures / opportunities*

Lappeenranta University of Technology aims to create a good working environment for its staff, and to support their professional development and well-being at work. Functions related to human resource administration are presented (in Finnish) in the quality manual of Personnel Services -unit.

The university has a human resources committee, which is responsible, among others, for personnel training. Through this committee, the university personnel has a representation in decision-making concerning the development of the working environment and conditions. The chair of the human resource committee is the Vice-Rector in charge of education. The names of other members and committee memoranda are available on the university intranet.

The university supports its staff members in maintaining and developing their professional expertise and in career planning. The human resource committee annually revises its measures for professional development and maintenance of professional expertise, which e.g. determine the focus areas of personnel training at the university.

The costs of staff training organised by the university are covered by general personnel training appropriations. Moreover, each unit offers its staff members the possibility to take part in staff training outside the university in order to support their professional development and expertise. Personnel training is part of each staff member's duties, and therefore, training is usually arranged during working hours. The university supports the professional development of its personnel by allowing them to take two lessons (2 x 45 minutes) per week for independent study if the employee's supervisor and head of the unit consider that the studies serve the purposes of the working community.

University regularly organises training in university pedagogy, which aims to strengthen the practical teaching competence. After participating in this training, the teacher is expected to be able to evaluate and develop his/her own teaching and assessment methods. The teachers of the department of Chemical Engineering are free to participate in any pedagogic courses available in Finland.

University staff members have annual performance and development discussions with their immediate supervisor. The parties of the discussion examine results obtained, and set goals for the near future which also concern professional development and personnel training needed. Instructions for performance and development discussions are available on the university intranet.

Professors are also obliged to participate in management training organised by the University.

#### 4.4 Financial and Physical Resources

##### 4.4.1 *Human resources*

The staff participating in teaching activities in the department includes professors, associate professors, post doctoral researchers, university lecturer and doctoral students (see Enclosure 24, Evidence of adequate teaching capacity). Professors and associate professors, who are normally in charge of the course modules and the major subjects, are mostly paid from public budget funds. This guarantees a solid foundation and continuity of the degree programme. Part of the funding for post doctoral researchers comes from external funding.

##### 4.4.2 *Physical resources*

A thorough renovation of the facilities of the department will be carried out at the period between December 2010 and September 2011. During this period, the teaching and research will be carried out in temporary facilities. After the renovation, the department will have modern and adequate laboratories suitable for high quality education and research.

Basic teaching and teaching materials, excursions, maintenance of the teaching equipment, rents and charges of the study affairs and the university administration are financed from the budget money from government.

##### 4.4.3 *Investment funds*

Basic investment funds per year are intended for normal laboratory equipment like scales, vessels, mixers, measurement devices etc.

##### 4.4.4 *Investment funds for major equipment purchased over the past three years or about to be purchased*

Major equipment purchased or to be purchased in this year are AAS (atomic absorption spectrophotometer), continuous ion-exchange workstation and freeze-dryer. The biggest single investment in 2009 was an IC (ion chromatograph). The biggest investment for next year is a complete renovation of the department.

Table 4.3. Financial resources of the programme.

Year	Course Funds, €					Invest. in major equipment
	Staff funds	Rents of offices and laboratories	Computers and equipment	Charge of study affairs services	Charge of university administration	
2008	2 064 502	480 014	215 547			4 241
2009	1 153 433	541 474		71 986	65 574	17 000
2010	1 803 758	501 130		91 106	93 038	85 000

#### 4.4.5 *Premises (refers to the whole university)*

There are 45 lecture and seminar rooms (auditoriums and smaller rooms) at the university designated for teaching. For language teaching the university has 5 language laboratories and 7 teaching rooms. The total number of computer rooms and other student workplaces is 21.

The university library offers services and facilities for the staff and the students of the university as well as other citizens. In connection with the library there is the student helpdesk Origo which consists of work places with support of information services. The facilities are equipped with top-of-the-line technology and software for e.g. group work, online studies, electronic exams, information retrieval, assignment submission, and final theses. There are 100 individual and several group work places and two computer rooms. There is also a reading room that is open 24 hours a day.

The university has two gyms and a sport hall for exercise activities. Several rooms are available for other extra-curricular student activities as well as two chapels. The student health service is also situated on the university.

There are two restaurants for the students and staff, another one in the main building and the other in the Student Union Building, adjacent to the main building of the University.

### **4.5 Support for Teaching and Study**

#### 4.5.1 *Computer facilities*

##### 4.5.1.1 *Computer equipment*

The University provides personnel with personal computers of a known brand for normal use, or a similar computer with more memory and enhanced display adapter for those who require CAD-software. The screens are mainly LCD screens. Both color and b/w printers and some scanners are available to the personnel.

Students can use the computers which are in common use in the library area or in the classrooms. These are mainly MS Windows-based computers of a known brand, but the library area also has a few computers using Linux operating system. Printers and scanners are available for students.

##### 4.5.1.2 *Student supervision / qualifications of the supervisory staff*

The student helpdesk Origo is located in the library area and the supporting team also supervises the students. Students form some of the support staff in Origo. Origo support staff have direct access to the helpdesk of the university Information Services and Technology (IS&T). IS&T unit staff are qualified in their field at the level B.Sc. or M.Sc.

##### 4.5.1.3 *Access, number of computers / pools, opening hours, etc*

Every student has access to every computer. There are 100 computers located in the library area, and they are available during the library opening hours. 239 computers located in classrooms are available when there are no lessons. There are 13 computing classrooms, of which 4 are equipped for CAD use and have 52 heavy use computers in total. One classroom with 20 computers has Linux setup. In addition there are 7 workshop rooms which have one or two computer each. In the thesis writing room there is 5 seats each optimized for research and writing. There are some computers in the corridors that can be used only for web browsing. These are typically used by students to check email.



Centralized services, such as learning environments can be accessed from outside of the campus. The university offers WLAN services to enable students to use their own computers on campus.

#### 4.5.1.4 *Description of the tasks performed by the students on PCs*

Students search and use publications that are available in the library or on the databases ([www.lut.fi/en/library](http://www.lut.fi/en/library)). They enrol on modules they are going to take (<https://weboodi.lut.fi/oodi> --> in English), get course information, learning material and assignments of the modules ([noppa.lut.fi](http://noppa.lut.fi) --> in English) and participate in web-based modules on the University's BlackBoard learning space. Students write reports, essays and theses on PCs. Software specific to studies are used to solve study-related problems and tasks. Email use and net browsing are other daily tasks.

#### 4.5.1.5 *Restrictions / hindrances*

There are no computers suitable for blind people. Computers should be used only in studying purposes.

#### 4.5.2 *Library / Literature / Media facilities*

##### 4.5.2.1 *Inventory*

LUT Library collections consist of c. 100 000 printed monographs, 67 000 printed journals, 18 000 electronic books, and 11 200 e-journals.

##### 4.5.2.2 *Other media*

The number of printed maps is 9, documents in microfiche form c. 1 100, and audio recordings 550.

##### 4.5.2.3 *Procurement / responsibility, coordination, etc*

Around 4200 printed monographs are produced annually and the library subscribes to 600 volumes of printed journals a year.

The library provides its customers with library and information services both on-site and online. Information literacy education for the entire University is also arranged and given by the Library personnel. The librarians act as experts in publishing LUT series. The Library personnel also manage the use of the customer and office space of the Library.

Within LUT, the library is classified as an Independent unit.

##### 4.5.2.4 *Student access / electronic access*

There are c. 266 000 yearly visits to the Library. The Library is open to LUT staff, students, and general public during termtime on workdays: Mon-Thu 8:30-18:00 and Fri 8:30-15:30. In summer and during the holiday season the Library closes at 15:30 on each workday. There are no restrictions to the number of loans.

Customers access the Library catalog Wilma 397 000 times per year. The Wilma database includes information about both printed and electronic books as well as the storage information from printed journals. Electronic books can be accessed via a link the Library catalog.

Over 20 database vendors with more than 100 databases are available for the Library customers. Most database hosts allow IP access to their information sources. Students and staff have also remote access to e-journals and electronic books.

The most important available databases related to Chemical Engineering are Elsevier, Springer and Knovel.

#### 4.5.2.5 *Staff qualifications*

There are 17 library staff, eight of whom have Master's degrees in science. Five staff members have professional library qualifications which equal to Bachelor's degrees. One of the staff members is an IT specialist.

#### 4.5.2.6 *Workplaces for students*

The number of seats for reading in the Library is 100. There are 95 computer workstations available for the customers. The Library also offers six workshop rooms with a total of 44 seats for group work.

#### 4.5.2.7 *Restrictions / hindrances*

The Library is closed during weekends. Electronic material is available remotely for LUT staff and students only.

#### 4.5.3 *Laboratory facilities / equipment*

##### 4.5.3.1 *Equipment and technical level*

Department of Chemical Engineering has well equipped laboratories designated just for teaching and research of chemistry, chemical engineering, and fiber and paper technology. There are two pilot halls for bigger equipment and process plant.

After renovation, the laboratory facilities will be more carefully designed and constructed for the needs of today. There will be separate laboratories for teaching and research. Some laboratories will be special equipped for working with difficult materials. Also storing and handling of the chemicals are taken carefully into account due safety aspects.

The department has basic chemistry equipment and analysers, like AAS, IC, SEM, particle size analysers and bigger pilot scale equipment for chemical and process engineering for example crystallizers, crushers and grinders etc. The Pulp and Paper Laboratory has its own facilities and specialized equipment for pulp and paper industry.

##### 4.5.3.2 *Student supervision / qualifications of the supervisory staff*

LUT Chemical Engineering has implemented a laboratory pass system which requires the student to complete certain procedures before he/she can start laboratory works. The pass includes supervision of the specific equipment to be used from the person in charge of the equipment as well as safety and other important aspects from the supervisor of the assignment.

##### 4.5.3.3 *Access, workplaces, opening hours*

Laboratories are open for the students at given times when they have free access to them. A student who is doing his/her Master's thesis at the university may have a license and a key to the laboratory.

##### 4.5.3.4 *Restrictions / hindrances*

Laboratories are not open during weekends.

For the safety reason undergraduate students are not allowed to work alone in any laboratory.

#### 4.5.4 *Academic guidance measures for prospective and existing students*

The University has contacts with study advisors and teaching staff at Finnish high schools and polytechnics to ensure that the counseling staff has up-to-date information about study possibilities at LUT. Printed material is posted to these educational institutions each autumn. The teachers and study advisors are given an opportunity to bring groups of students to LUT and visit the physical premises (laboratories, library etc) and have a guided tour on the LUT campus. Annually in November, all high

schools in the surrounding regions (abt. 200 km range) are invited to an open house event, where the programme and information provided is tailored for high school seniors.

LUT's own degree students systematically visit high schools and garrisons where young Finns do their compulsory military service. The motivation for these visits is to provide information on the study possibilities and student life. More than one hundred of these presentations are given by LUT students each academic year. LUT also takes part in the most important national fairs targeted at young people seeking higher education opportunities.

LUT also offers a forest industry related study programme for some of the closest located high schools. The programme is conducted in cooperation with globally-present pulp and paper industry companies operating in the south-eastern part of Finland. Students on the programme complete five modules at LUT which are credited in their high school study programme. One module is provided by the Department of Chemical Technology. The students are able to apply to LUT without having to take part in the entrance examination. The department has also arranged special events and courses for the secondary school students in cooperation with local schools.

The University offers existing students academic guidance measures which together cover the entire span of studies and supports effective study and learning, allowing student to complete their studies following an appropriate study plan that they have prepared themselves and to graduate within the desired time. The roles and duties of study guidance personnel and units are listed in the table below.

Table 4.4. Academic guidance methods

<b>Peer tutor</b>	Introduces new students to the university, studies and the student community, and helps them with practical arrangements at the start of studies. A peer tutor introduces new students to the university facilities, study guidance staff and other students. A peer tutor makes sure that students know the most important practices related to studies: registration for courses, attending lectures, taking examinations, preparing a course schedule, social aspects.
<b>Tutoring coordinator</b>	Coordinates and develops the university's peer tutoring together with faculties, Student Services and the student union.
<b>Student adviser</b>	Student advisers are LUT students who work part-time while they study. They provide information and guidance in studies, see to the choice of tutors and arrange their training together with study coordinator, take part in arranging briefings for students.
<b>Study counselling psychologist</b>	Counsels students in problems related to studies and learning, provides expertise in issues involving learning and guidance, supporting other study guidance personnel.
<b>Study coordinator</b>	The study coordinator normally coordinates study guidance for students. The duties include study and degree guidance for students, from applicants to postgraduate and partly even mature students. The study coordinator helps students in preparing their individual study plan (including the recognition of prior learning and studies outside LUT, e.g. through the flexible right to study) and provides guidance in administrative issues related to graduation. The Language Centre study coordinator offers study guidance with regard to language and communication studies, and handles credit transfer applications for language and communication studies completed at other universities and higher education institutions.
<b>Head of degree programme</b>	A head of degree programme is in charge of evaluating and developing study guidance .
<b>Head of study affairs</b>	Is responsible for organising study guidance in the faculty. Is responsible for administration of studies and partly also for study guidance related to administrative affairs.
<b>Teacher/tutor</b>	A teacher/tutor helps students prepare their individual study plan and follow its progress. Teacher/tutors provide guidance in the selection of major and minor subjects from the viewpoint of career guidance. They are study guidance personnel appointed for a department or degree programme. Students may turn to them with any issues involving studies.
<b>Teachers</b>	Teachers are responsible for study guidance related to the completion of the courses/modules they are responsible for.

<b>Introductory course/module</b>	Introductory course is arranged to help students get started with their academic studies. Introductory courses usually also guide in preparing an individual study plan.
<b>Professors</b>	Professors provide guidance in the selection of a research topic, and in preparing final theses for undergraduate and postgraduate studies.
<b>International Services</b>	International Services offers general study guidance to international students at the university and coordinates the activity of international tutors. International Services also assists Finnish students in matters related to studies abroad.
<b>Career Services</b>	Career Services guides students in career planning and searching for employment.
<b>Language Centre</b>	The Language Centre offers study guidance related to language, communication and culture studies.
<b>Library</b>	Guidance in information retrieval. Instruction in information literacy.
<b>Origo helpdesk</b>	Support services for the use of information and communication technology in studies.

## 5 Attainment of Objectives

### 5.1 Data and statistics on the success of the degree programme

Success of the Bachelor's Degree Programme has not been monitored in LUT because almost all Bachelors continue their studies in LUT. Success of the Master's Degree Programme is monitored with student feedback and with feedback received from graduates.

All statistics related to the Master's Degree Programme are illustrated in Enclosures 12 (Success of the Master's Degree Programme of Chemical Engineering in LUT) and 13 (Module feedback). All the questionnaires are found in Enclosure 14: course feedback questionnaire and surveys for graduates.

### 5.2 Overview and assessment of external evaluation outcomes

#### a) External auditing of the Finnish Higher Education Evaluation Council (FINHEEC)

The objective of the FINHEEC audit is to ensure that the higher education institution has a quality assurance (QA) system that supports continuous development of activity. The audit also ensures that a higher education institution operates in accordance with its objectives and the activity is internationally reliable. LUT was audited in 2009 and the audit is valid until 2015. The abstract of the FINHEEC audit results which for LUT is given in Enclosure 15.

#### b) Council for developing the education

The Department of Chemical Engineering has arranged once a year a one day meeting with students and delegates of the chemical industry to discuss different aspects that concern the development of chemical engineering education. The latest meeting was held in February 2010. The council has discussed about e.g. learning outcomes needed from the point of view of industry, developments in teaching methods, and future prospects of industry concerning the qualifications needed. These discussions are important input in the programme development process.

#### c) Feedback from the Master of Science Thesis supervisor's

A new procedure concerning employer feedback was introduced at the beginning of 2010: The University monitors up the satisfaction of employers/supervisors with the competences of the student and the outcomes of thesis written in the context of their company. The satisfaction of employers/supervisors with the outcome of thesis projects on Chemical Engineering is good (mean 8,6 on the scale 4-10).

**d) Follow-up of the progression of studies**

LUT has monitored up the progress of studies and the accumulation of credits each year since 2005. This follow-up has been done as part of a nationwide project, which has shown that the study process in LUT is among the most effective of Technical Universities and Faculties in Finland (see in Finnish <http://lib.tkk.fi/Raportit/2009/isbn9789512297740.pdf> ).

**5.3****Overview and assessment of internal evaluation outcomes****a) Internal auditing in LUT**

Internal auditing is a part of quality management of Lappeenranta University of Technology. Internal audits are carried out systematically every two- or three years. In autumn 2008 internal auditing focused on quality management system of research activities in the Faculty of Technology. Under evaluation were the university's main quality manual and the quality manual of the Faculty of Technology.

The internal audit report stated that the quality management system has supported Faculty of Technology management in developing the Faculty. Furthermore, it was noted that Faculty of Technology personnel were well disposed towards auditing and development suggestions. Good practices according to the report were included co-operation with employers. Safety instructions were well described and documented. Research projects presented in auditing interview were documented carefully and appropriately. It was concluded that the Department of Chemical Engineering council for developing the education represents good practice which could be implemented in use in other units, too.

**b) Financial quality bonuses in the University**

Lappeenranta University of Technology grants quality bonuses for the development of their education. The quality bonus is a reward for development measures taken and an incentive for the future development. The Department of Chemical Engineering has received the quality bonus for the years 2006-2007, 2008 and 2010. These bonuses have supported the educational development measures that are important in the department and also strategically relevant for the university.

The LUT Centre for Separation Technology (CST) has received bonus for a centre of excellence in research every time the bonus has been granted. CST is closely linked to the Department of Chemical Engineering and has close contacts with industry on the professional field.

**c) Nominations by the Student Union of LUT**

The Student Union of LUT nominates each year a Lecturer of the Year (both a national and an international nomination). It also gives a prize for the best study module (best handout material). Criteria for the nominations are explained in Enclosure 16. Associate Professor Jaakko Partanen and Lecturer Riitta Mennola from the department have received such a nomination.

**d) Feedback from the students of Chemical Engineering**

In spring 2010 student of chemical engineering received a questionnaire asking for their opinions of the quality of education offered in the department. The questionnaire was sent to both Bachelor students and to Master of Science students. Students were asked if they intended to continue their studies in Chemical Engineering during the following semester and, if not, why. They were also asked to give some suggestion for improving the programme content and how they would enhance tutoring of the first year students. They are also asked to give any further feedback about the degree programmes.

#### 5.4 Number of students commencing each degree programme

Table 5.4 shows the annual number of new students. At the moment LUT automatically gives for students enrolling on the Bachelor's degree also the right to study the Master's degree programme in the same department. For this reason the students who have completed the Bachelor's degree are not compiled in the statistics "First-Year Enrolments Master's degree" but it is assumed that they will complete also the Master's degree. The numbers announced as enrolments on the Master's degree represent the students selected directly to the Master's degree programme including the students on the international degree programme (see section 4.1.4).

Table 5.4. First-Year enrolments over the past five years, broken down by degree programme.

First-Year Enrolments					
Degree programme	2009	2008	2007	2006	2005
Bachelor	37	37	35	35	32
Master	39	35	18	28	36
<b>Total</b>	<b>76</b>	<b>72</b>	<b>53</b>	<b>63</b>	<b>68</b>

Source: LUT intranet

#### 5.5 Number of students per course semester and degree programme

In Table 5.5 students are divided by different degree programmes and semesters.

In Finland the time to allowed complete university studies has traditionally been very flexible. The first students who had time limit for their studies were enrolled in 2005. This phenomenon can be seen in the Table 5.5, as there are very many "N" year students, meaning students who have been studying longer than five years. A Bachelor's degree theoretically takes three years, but students who have not completed their studies in six semesters, are called "Bachelor N students".

The trend lines showing drop-out rates are also seen in Table 5.5. For example, for the Bachelor's degree, the total number of first-Year students was 31 during semester 07/08. In semester 08/09, 25 of them were still continuing their studies, and in 09/10 22 were present in LUT. The same kind of trend lines can be drawn also for the Master's degree programme. 34 first-year students were enrolled in semester 08/09. 28 of them have continued their studies in the following semester.

Table 5.5. Students broken down by degree programme and semester of study.

Students Broken Down by Degree Programme and Semester of Study									
Degree Programme	Bachelor Degree				Master Degree				
Academic Year	1	2	3	N	1	2	N	TOTAL	
Total 09/10	38	30	<b>22</b>	73	35	<b>28</b>	83	309	
Total 08/09	32	<b>25</b>	24	56	<b>34</b>	26	108	305	
Total 07/08	<b>31</b>	31	31	38	35	57	87	310	
Total 06/07	39	38	57	1	66	56	75	332	
Total 05/06	38	67	65	0	67	34	69	340	

Source: LUT intranet

## 5.6 Graduates

Table 5.6 show how many Bachelors / Masters of Science have graduated from the Chemical Engineering in the last 5 years. The values for the Master's programme contain all the students finishing Master's programme (including students who have completed the Bachelor's degree and all international students finishing the international degree programme, see section 4.1.4).

Table 5.6 Graduates from the Department of Chemical Engineering during 2005-2009.

Graduates, Broken Down by Degree Programme					
Programme type:	Academic Year 2009	Academic Year 2008	Academic Year 2007	Academic Year 2006	Academic Year 2005
Bachelor	11	6	-	-	-
Master	49	35	53	34	39
<b>Total:</b>	<b>60</b>	<b>41</b>	<b>53</b>	<b>34</b>	<b>39</b>

Source: LUT intranet

## 5.7 Student/staff- ratio

Teaching staff / student – ratio at the department has been the following:

Table 5.7 Student/staff-ratio in the Department of Chemical Engineering.

Bachelor and Master of Science degree programmes	2009	2008	2007	2006	2005
Student/staff-ratio	4,9	3,9	4,3	4,2	4,4

## 6 Quality Assurance Measures

The key aim of quality management and development at Lappeenranta University of Technology is to incorporate quality management into the normal activity of the university, with the underlying idea of continuous improvement. The university's quality management system covers the entire range of education provided by the university (undergraduate education, postgraduate education, continuing education and open university education), research, societal and regional interaction, and support services. The quality management system is described in the main quality manual and the subordinate quality manuals of faculties and other organisational units. The quality manuals are available in the University intranet. (Enclosure 22.)

Quality goals of education given in the Faculty of Technology are the same as those given in the University's quality manual. These goals are:

- The education provided by Lappeenranta University of Technology is competitive and of a high standard, and yields results
- Large study opportunities
- Students at the university will obtain high-level academic know-how, including: how to utilize and apply their skills in both further studies and the world of work, and how to adapt to the changing needs of the labor market and react to them appropriately and how to operate in an international environment.
- The university's students and employers of LUT graduates are satisfied with the contents and implementation of the studies. The teaching staff is satisfied with the conditions provided by the University for teaching.

Education in the Faculty of Technology includes also the following principles:

- Education is based on the basic principles of natural sciences
- Education meets the needs of industry.

## **6.1 Evaluation during the degree programme**

During their studies students complete several questionnaires with which they give feedback and opinions concerning their studies and the study conditions in the university. At the beginning of their studies students are asked to fill in a questionnaire concerning the progress of their studies and tutoring. A feedback questionnaire to students and peer tutors helps to evaluate whether the start of university studies and initial study guidance have been successful. The feedback survey is carried out annually by the Student Affairs Office. The feedback combined with practical experiences will be used to develop study guidance for new students and tutor training.

The Student Union surveys the state of well-being of students every other year. The results of the questionnaire are communicated to the university personnel.

A study plan is an important tool to evaluate the progress of studies of an individual student. All LUT students prepare a study plan (HOPS) at the beginning of their studies. All individual study plans are evaluated and confirmed in accordance with faculty or department procedures. In the programme of Chemical Engineering, the Head of the degree programme approves the study plans.

The progress of studies and the accumulation of credits is monitored by the Student Affairs Office. The results are reported to the degree programmes, and the follow-up reports are available on the LUT intranet. The accumulation of credits is also examined annually to confirm students' eligibility for student financial aid from the Social Insurance Institution of Finland (KELA). Statistics on ECTU accumulated are compiled annually for each faculty, and the number of completed credits is one of the grounds for resource allocation to departments.

Module evaluations are carried out in each module on a yearly basis. The evaluations are carried out as web-enquiries (see Enclosure 14). Standard questions for all enquiries concern the appropriateness of teaching and the general impression of the study module. In addition, teachers are able to add their own questions to the enquiries if they wish. Module-specific evaluations are given to the teachers responsible for the modules. The results are also delivered to the directors of the degree programmes and the Vice Rector responsible for education once in a semester. If an individual module receives a low average score (less than 2.5 on a scale 1-5, with 5 being the highest score), the Vice Rector discusses about the problem with the Dean and/or the Head of the degree programme. Module evaluations are also discussed in the result and development negotiations between the University and the Faculty.

## **6.2 Evaluation of the success of the degree programme**

The university management, faculty management, heads of departments and heads of degree programmes are responsible for ensuring that the education provided by the university is efficient and of a high standard. The success of the degree programme is evaluated in many ways (results can be seen from Enclosure 12 and sections 5.4-5.7):

- Skills and knowledge are demonstrated in a final thesis, which is prepared by all Bachelor's and Master's level students. Skills in the student's native language are demonstrated in a maturity test at the end of the Bachelor's degree studies.



- Information about the number of graduates as well as their employments describes the quantitative results of the degree programme.
- Student mobility is monitored by International Services (section 4.2.2).
- Satisfaction with the education given is surveyed at the time of graduation and five years after graduation.
- Employer feedback is collected e.g. through an extended teaching council which includes employer representatives.
- Satisfaction of employers/supervisors is followed up by with evaluation of the outcome of thesis projects and in the skills of the students as they transition into the world of work.

### **6.3 Further development of the degree programme – ongoing improvement**

The Department of Chemical Engineering has its own advisory group for teaching. The role of this group is to help the Head of the Programme in developing of teaching in the degree programmes. The group has e.g. developed the common module feedback system and evaluated systemically the feedback students have given. Once a year the group meets the representatives from industry and deals with e.g. the qualifications needed in working life.

The University is actively involved in a number of different national and international development projects for teaching. The vice-rector in charge of education decides on development projects which LUT engages in and starts to promote. The Department of Chemical Technology has participated e.g. in the Virtual University project and developed several web-based modules. The department also participated in a project that focused on promoting the completion of Master's degree in five years. The pilot project of the department was to evaluate the workload of the curriculum in point of view of certain modules. The results of this projects have influenced for instance teaching methods and guidance given to students.

The university has granted quality bonuses for the development of education since 2006. The quality bonus is a reward for development measures taken and an incentive for further development of education and teaching. The Department of Chemical Technology has got the bonus for the years 2006-2007, 2008 and 2010.

The pay system of the University provides an incentive for teachers to develop their teaching and pedagogical skills. The job classification of the teaching staff is based on scientific qualifications and their development, the development of teaching skills and the variety of teaching duties, and responsibility for one's field of science and its development.

The personnel of the Department of Chemical Engineering participates actively in training and education offered by the University and other organizations. The University annually offers its teaching staff a study module in university pedagogy (worth 25 ECTU, see also 4.3.3.) and in the use of information and communication technology in instruction. Professors are also obliged to participate in management training.

For teaching positions, the university recruits professionals with not only strong scientific expertise in the field in question, but with pedagogical skills, as well. To this end, applicants for teaching positions must also submit a teaching portfolio or another report on their teaching qualifications. Instructions for compiling a teaching portfolio are available on the intranet. In addition, the appointment of professors requires a demonstration lecture from the applicant.

**ENCLOSURE LIST**

**Only the enclosures 1a, 1b, 3 and 5 are included in this publication.**

**1a. Learning Outcomes, Bachelor's Degree Programme****1b. Learning Outcomes, Master's Degree Programme**

2. Minutes of a meeting of the teaching committee

**3. List of Modules**

4. University Regulations on Education and the Completion of Studies

**5. Module Handbook**

6. Workloads of Bachelor's and Master's Degree Programmes of Chemical Engineering

7. LUT Teacher's Quality Manual

8. Assessment matrix of the Bachelor's and Master's thesis

9. Examination Regulations

10. Research groups of Chemical Engineering

11. Staff Handbook

12. Success of the Master's Degree Programme of Chemical Engineering in Lappeenranta University of Technology, LUT

13. Module feedbacks from the years 2004-2010

14. Feedback questionnaires

15. External auditing of LUT

16. Nominations given by the Student Union of LUT

17. Examples of Bachelor's Degree Structures

18. Examples of Master's Degree Structures

19. Description of the contents of the Major and Minor Subjects

20. Diploma Supplement of Bachelor of Science

21. Diploma Supplement of Master of Science

22. Quality manual of LUT

23. Strategy of LUT

24. Evidence of adequate teaching capacity