The Chemistry "Euromaster"

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The Aims of the Euromaster

The primary aims of the Euromaster qualification are to provide a second cycle degree of the highest standard which will be:

- ***recognised by other European institutions as being of a standard which will provide automatic right of access (though not right of admission, which is the prerogative of the receiving institution) to chemistry doctoral programmes.***
- ***recognised by employers as being of a standard which fit the graduates for employment as professional chemists in chemical and related industries or in public service***
- ***recognised by the European Chemist Registration Board of EuCheMS as meeting the educational standard necessary to allow the graduates to obtain the status of European Chemist.***

It must be made clear at the outset that each institution providing Master-type degree programmes in chemistry is completely free to decide on the content, nature and organisation of its courses or modules. These degree programmes must relate to the European Qualifications Framework for the European Higher Education Area (EHEA) and to the corresponding National Qualifications Framework.
Chemistry degree programmes offered by individual institutions will thus logically have their own particular characteristics. The extent to which individual aspects are treated will vary with the nature of specific programmes.

Outcomes: The Descriptor

The goals of a second cycle study programme can be described by the "Budapest" Descriptors developed in May 2005 by the Chemistry Subject Area Group working in the project "Tuning Educational Structures in Europe". They are as follows:

Second cycle degrees in chemistry are awarded to students who have shown themselves by appropriate assessment to:

- *have knowledge and understanding that is founded upon and extends that of the Bachelor's level in chemistry, and that provides a basis for originality in developing and applying ideas within a research context;*
- *have competences which fit them for employment as professional chemists in chemical and related industries or in public service;*

- *have attained a standard of knowledge and competence which will give them access to third cycle course units or degree programmes.*

Such graduates will:

- *have the ability to apply their knowledge and understanding, and problem solving abilities, in new or unfamiliar environments within broader (or multidisciplinary) contexts related to chemical sciences;*
- *have the ability to integrate knowledge and handle complexity, and formulate judgements with incomplete or limited information, but that include reflecting on ethical responsibilities linked to the application of their knowledge and judgements;*
- *have the ability to communicate their conclusions, and the knowledge and rationale underpinning these, to specialist and non-specialist audiences clearly and unambiguously;*
- *have developed those learning skills that will allow them to continue to study in a manner that may be largely self-directed or autonomous, and to take responsibility for their own professional development.*

Transition to the Third Cycle

The chemistry Euromaster should, provided that his/her performance has been of the required standard, be able to continue his/her tertiary education either at his/her degree-awarding institution, at another equivalent institution in his/her home country, or at an equivalent institution in another European country. (At a later stage one can hope that world-wide acceptance of the Euromaster qualification will come into being).
This continuation will take the form of a course leading to a doctoral degree, either in chemistry or in related fields. Any master programme must end with a Thesis, as this will generally be considered to be the necessary prerequisite for access to the Bologna third cycle.
It is of pre-eminent importance that institutions offering Euromaster qualifications aim for high standards, so as to give their students good chances in the national or international job market as well as a good starting point to transfer to doctoral programmes should they wish to do so.

Master Programmes in the Context of Bologna

As a result of the Bologna Declaration, there are moves under way throughout Europe to revise chemistry degree structures. As decided at the Berlin conference in September 2003, a three-cycle structure is to be implemented ("BSc/MSc/PhD"). However, there is no general agreement on introducing the “3-5-8” model which has sometimes been misunderstood as the Bologna “recommendation”.
The Helsinki Master Conference of March 2003 provided the following recommendation: Master study programmes should involve 90-120 credits, at least 60 of which must be *at Master level*. This recommendation was used in defining the Second Cycle in the Qualifications Framework for the EHEA. Master programmes with a research orientation form a link between the EHEA and the European Research Area.
In this European Qualifications Framework, the length of the Bachelor degree is defined as 180 to 240 credits.
Thus any national requirement that a combination of Bachelor and Master must be necessarily

equivalent to 300 credits is contrary to the provisions of the European Qualifications Framework, which foresees a "corridor" of 270 (180 + 90) to a maximum of 360 (240 + 120) credits for a combination of Bachelor and Master. Mobile students must not be penalised by not allowing a Bachelor graduate with a 180-credit degree to take a 90-credit Master.

Euromaster programmes will normally require 90-120 ECTS credits.

Countries which have traditionally had "long" degrees qualifying for admission to PhD training will generally consider the Master programmes which they introduce to be similar in aim to the higher semesters in their earlier long degrees, but must of course not simply split long programmes into two (unequal) parts, which they then label Bachelor and Master.

Judging the Quality of Euromaster Programmes: "Fitness for Purpose"

Since it is neither necessary nor advisable to set up stringent parameters for a Master programme in chemistry, the question immediately arises as to how a programme can be judged when a "Euromaster Label" is under consideration.
The "Budapest Descriptor" gives a global description of the aims of such a programme, and institutions are advised on the basis of this descriptor to start planning their programme by drafting a statement which defines the aims and the profile of the programme. Such a statement, which will probably run to between one and two pages of A4 text when a 12-point typeface is used, will describe the elements of the programme with reference to the above descriptor. It will describe the skills and competences which the graduate will have amassed at the end of the programme.
This statement defines the purpose of the programme, and the accreditation process will then be designed to find out whether the programme as set out in detail in the application is fit for the purpose for which it is designed.
The points which follow should be mentioned as appropriate in the statement of aims and profile, and will be the subject of questions in the Guidelines for Applicants.

Access and Entry

According to the conclusions of the Helsinki conference on Master degrees: ***"All bachelor degrees should open access to master studies and all master degrees should give access to doctoral studies"***. Access is also considered in detail in the Lisbon recognition convention, which has so far been ratified by 40 countries and international institutions.
The prerequisite for entry will be **either** a qualification of Eurobachelor® standard **or** a first cycle degree in one of the disciplines defined by the institution for that particular programme.
Transnational mobility at the Bachelor/Master interface will often involve setting up admissions procedures at a level *previously unknown* in many European countries. While European students will be aided by their possession of the Diploma Supplement, the detailed information which the latter contains may often not be available for students from countries outside the EHEA.
If Europe wishes to *compete* with countries such as the USA for the best graduate students, it must offer structures and possibilities as least as good as those present in such countries. Many regret that in the USA a Master in chemistry will very often in fact be a "failed PhD", and they plan to develop high quality programmes leading to Masters who are *not* failed PhD's.

The Number of Credits

As stated above, Master study programmes should involve 90-120 ECTS credits, at least 60 of which must be *at Master level*. A normal academic year corresponds to 60 ECTS credits, a European average workload of 1500 hours and an average of 40 weeks per year during which the student will be studying.
Why the emphasis on "at Master level"? Because of the expected flexibility of Master programmes, it may for example be possible in a particular institution for a Physics Bachelor to enrol as a Chemistry Master. In such a case, the Master candidate may well have to make up work (*at Bachelor level*) in order to be able to reach the defined learning outcomes.
Depending on the structure of the individual programme and the number of credits involved, these may be EXTRA credits or may be included in the 90 or 120 which the complete programme carries.
Such "bridging" modules or course units must be given credit and mentioned in the Diploma Supplement.

The Master Thesis

The academic goal of the Master degree in the chemical sciences is to give graduates a research experience much broader and deeper than that involved in the limited Bachelor Thesis. The intention is the graduate will successfully complete a research project, the outcome of which is of a quality that is potentially publishable.
Thus the Master Thesis should normally carry at least 30 credits.
The Thesis will be written in the language prescribed by the institution and defended according to the rules of the institution. It should be remembered that Thesis presentation can be used as a tool for improving presentation skills, also in a foreign language.
The supervision (and assessment) of the Master thesis must be transparent.

Teaching Staff

The thesis supervisors referred to above bear a heavy responsibility in the Master programmes, as indeed do all members of staff involved at teaching at this level. Institutions applying for a Euromaster Label will be asked to provide brief details of the members of the teaching staff involved in the degree programme and of their recent publication records and other scholarly activity.
This information is necessary in order to judge the background of the programme. Naturally no outside interference in the teaching staff policy of the institution is intended.

Outcomes: Subject Knowledge

By its very nature, a Master programme will be much more flexible than a Bachelor programme. It is therefore neither necessary nor advisable to list areas of subject knowledge which the programme should cover. According to the needs of the institution, such programmes will be either broadly-based or specialised. Thus the second cycle graduate will often have an in depth knowledge of an area of specialism in chemical science.

Euromaster programmes will have NO defined "core" comparable to the "core" of 90 credits in the Eurobachelor® framework.

Outcomes: Abilities and Skills

In addition to the aspects covered in the Descriptor, the following points should be taken into account.
At Euromaster level, students coming from a chemistry Eurobachelor® background are expected to develop further the range of abilities and skills already gained in the Eurobachelor® programme. If they come from a *different* undergraduate background, these abilities and skills may not always be present, but may need development during the Master phase.
The abilities and skills may be divided into three broad categories:
a. Chemistry-related cognitive abilities and skills, i.e. abilities and skills relating to intellectual tasks, including problem solving;
b. Chemistry-related practical skills, e.g. skills relating to the conduct of laboratory work;
c. Generic skills that may be developed in the context of chemistry and are of a general nature and applicable in many other contexts. The generic skills defined in the Eurobachelor® document, which need to be developed further as appropriate during the Master phase, are listed in Appendix 1.
The main abilities and skills that students are expected to have by the end of their Euromaster programme in chemistry, are as follows.

a. Chemistry-related cognitive abilities and skills
Ability to demonstrate knowledge and understanding of essential facts, concepts, principles and theories relating to the subject areas studied during the Master programme.
Ability to apply such knowledge and understanding to the solution of qualitative and quantitative problems of an unfamiliar nature.
Ability to adopt and apply methodology to the solution of unfamiliar problems.

b. Chemistry-related practical skills
Skills required for the conduct of advanced laboratory procedures and use of instrumentation in synthetic and analytical work.
Ability to plan and carry out experiments independently and be self critical in the evaluation of experimental procedures and outcomes.
Ability to take responsibility for laboratory work.
Ability to use an understanding of the limits of accuracy of experimental data to inform the planning of future work.

c. Generic skills
Study skills needed for continuing professional development.
Ability to interact with scientists from other disciplines on inter or multidisciplinary problems.
Ability to assimilate, evaluate and present research results objectively

Curricular Structure

It is highly recommended that the Euromaster course material should be presented in a modular form, whereby modules should correspond to at least 5 credits. The use of double or perhaps triple modules can certainly be envisaged, the Master Thesis requiring at least 30 credits. Apart

from the Master Thesis, it appears logical to define modules as being compulsory, semi-optional (where a student is required to select one or more modules from a limited range), and elective (where the student may choose one or more modules from a normally much wider range).
Students must be informed in advance of the expected learning outcomes for each module.
Each individual institution will of course make its own decision as to the distribution of credits between compulsory, semi-optional and elective modules.
Because Euromaster programmes will often allow the student a considerable amount of freedom of choice when selecting course units or modules, institutions should provide study advisers to give guidance on course unit/module selection.

Language

At Euromaster level, where the research component forms a main component of the programme, language proficiency ***must*** include ***communication competences*** in English, the *lingua franca* of scientific communication. Competences in reading and understanding English should be achieved automatically, since the vast majority of the chemical literature to be consulted is now written in this language.

ECTS and Student Workload

A European average for the total (expected) student workload per year is close to 1500 hours; this figure refers to full-time students in a standard academic programme. For most institutions, this is based on a working week of 40 hours. Thus it is important to have clear guidelines on student workload distribution. These should always include definition of pre-examination study periods and examination periods separate from the teaching period, as these periods form an integral part of the total workload.
When defining workload for the different teaching/learning elements of a chemistry degree course it must be taken into account that, for example, the total workload connected with a 1-hour lecture is different than that corresponding to 1 hour of practical work.
Initial institutional estimates of workload for the average student will of course not necessarily be correct; thus there must be a clear mechanism for continuous student feedback on actual workload and the use of this feedback to correct the structure of programmes where necessary.

Modules and Mobility

Mobility must be an important feature of Euromaster qualifications. It should be possible throughout the course, but particularly at the Thesis level, where use can be made of existing research cooperation with external partners.
Mobility will be restricted unnecessarily if institutions define a high proportion of course modules as being "non-transferable", i.e. they must be taken at the home institution.
Modules or course units should be fully described according to the ECTS "Key Features"(ec.europa.eu/education/programmes/soctates/ects/index_en.htm). Thus the following information is necessary for each course unit:

- Course title
- Course code
- Type of course
- Level of course

• Year of study
• Semester/trimester
• Number of credits allocated (workload based)
• Name of lecturer
• Objective of the course (expected learning outcomes and competences to be acquired)
• Prerequisites
• Course contents
• Recommended reading
• Teaching methods
• Assessment methods
• Language of instruction

Compensation

The Chemistry Euromaster does not recommend compensation (in which failed modules/course units are considered to be "passed" because of an overall grade average.

Recognition of Credits Gained Abroad

The Euromaster is concerned with mobility and recognition. Thus Euromaster institutions must guarantee automatic recognition of credits gained at foreign host institutions if they have been obtained according to the terms of a learning agreement. The Euromaster institution must comply with the standard ECTS procedures:

- Learning agreements must be concluded with students going abroad before their departure and corrected if necessary during the stay at the host institution
- Because the learning agreement is a contract, it must be signed by someone in the Euromaster institution who is responsible for recognition as well as by the student and a responsible representative of the host institution
- Credits gained which are listed in the learning agreement must be recognised automatically and should be referred to or listed in the Diploma Supplement issued to the graduate. Alternatively, the Transcript of Records issued by the host institution can be appended to the Diploma Supplement.
- Grade transfer, if it occurs, must be carried out on the basis of ECTS rankings. If the foreign host institution does not use ECTS rankings, a procedure for grade transfer must be used which does not result in “downgrading” of the grades awarded by the host institution

Methods of Teaching and Learning

A wide variety of learning and teaching approaches is to be recommended. The element of research involved in a Euromaster course will, as stated above, be considerable.
Lectures should be supported by multimedia teaching techniques wherever possible and also by problem-solving classes. These offer an ideal platform for teaching in smaller groups, and institutions are advised to consider the introduction of tutor/mentor systems as a standard feature of Master programmes, where the student will need guidance on his or her study programme because of the initially unexpected degree of freedom in choosing modules/course units.

Assessment procedures and performance criteria

The assessment must be designed to cover the defined learning outcomes.

a) Coursework

The assessment of student performance must involve as many procedures as possible, such as:

- Written examinations
- Oral examinations
- Laboratory reports
- Problem-solving exercises
- Oral presentations
- Preparation and displays of posters reporting thesis or other work.

Since Euromaster programmes are credit-based, assessment should be carried out with examinations at the end of each term or semester. It should be noted that the use of ECTS does not automatically preclude the use of "comprehensive examinations" at the end of the degree course; if these are used they must however also be included in the credit distribution process and carry appropriate credits!
Examination questions should be problem-based as far as possible; though essay-type questions may be appropriate in some cases, questions involving the reproduction of material learned more or less by heart should be avoided as far as possible.
Members of the teaching staff should aim for a consistent and transparent policy on assessment.

b) The Thesis

To ensure comparability of standards throughout institutions operating the programme, a significant part of the assessment should be 'competence based'. Different levels of performance clearly need to be defined, and this can be facilitated through a series of statements which describe student skills, attitude and behaviour during the Master Thesis. Attainment levels achieved by particular students can then be judged and compared. For example, keys to a successful Master Thesis are the intellectual and scientific input of the student, the comprehension of the project, organisation and planning besides a well-written report.
The following two statements might encapsulate the range of abilities expected of students under the heading of *Intellectual and scientific input*: 'The student demonstrated an enquiring mind and an ability to innovate by controlling the direction of the project' and 'The student provided a technical rather than an intellectual contribution to the project'. Such statements can be equated to a mark or grading. Use of such grading tools allows us to move beyond the sometimes subjective assessment of a written document which only reports on the outcome and background to a project. Used in conjunction with a report, student log book, oral presentation and poster, such a range of assessments can provide a very accurate picture of student ability.

Grading

While the national grading systems will be used initially, it seems necessary to aim for the

establishment of a recognised pan-European grading system.

The Diploma Supplement

All chemistry Euromasters must be provided with a European Diploma Supplement (as described under http://europa.eu.int/comm/education/policies/rec_qual/recognition/diploma_en.html) in English and if required in the language of the degree-awarding institution.

Quality Assurance

The chemistry Euromaster designation will be a quality label and must involve national chemical societies and their pan-European counterpart (the European Association for Chemical and Molecular Sciences (EuCheMS)) as well as wider European chemistry organisations such as CEFIC and AllChemE. It will thus involve the formation of one of the first trans-national European quality assurance networks in the emerging European Higher Education Area.

Appendix I

Generic competences as defined in the Eurobachelor® framework

- The capacity to apply knowledge in practice, in particular problem-solving competences, relating to both qualitative and quantitative information.
- Numeracy and calculation skills, including such aspects as error analysis, order-of-magnitude estimations, and correct use of units.
- Information-management competences, in relation to primary and secondary information sources, including information retrieval through on-line computer searches.
- Ability to analyse material and synthesise concepts.
- The capacity to adapt to new situations and to make decisions.
- Information-technology skills such as word-processing and spreadsheet use, data-logging and storage, subject-related use of the Internet.
- Skills in planning and time management.
- Interpersonal skills, relating to the ability to interact with other people and to engage in team-working.
- Communication competences, covering both written and oral communication, in one of the major European languages (English, German, Italian, French, Spanish) as well as in the language of the home country.
- Study competences needed for continuing professional development. These will include in particular the ability to work autonomously.
- Ethical commitment

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Veću Departmana za hemiju
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Komisiji za akreditaciju i kontrolu kvaliteta Departmana za hemiju

10.11.2011

PREDMET: Usvajanje dokumenta „Referentni obrazovni standardi za hemiju i srodne discipline"

U okviru Tempus projekta „Modernisation of Post-Graduate Studies in Chemistry and Chemistry Related Programmes" definisan je dokument „Referentni obrazovni standardi za hemiju i njoj srodne discipline" od strane članova timova sa četiri državna univerziteta u Srbiji (Novi Sad, Beograd, Kragujevac i Niš), Srpskog hemijskog društva, kao i timova sa 5 evropskih univerziteta (Grinič, Ahen, Brno, Nova Gorica i Galati). Bilingvalni tekst „Benchmark Standards for Chemistry and Chemistry Related Subjects/Referentni obrazovni standardi za hemiju i srodne discipline", koji će biti objavljen u Hemijskom pregledu (trenutno u štampi), dat je u Prilogu ovog dopisa.

Dokument je definisan u cilju međuinstitucionalnog usaglašavanja sadržaja Standarda broj 4 akta: „Standardi za akreditaciju visokoškolskih ustanova i studijskih programa". Standard broj 4. definiše kvalifikacije koje stiču studenti po završetku svakog studijskog ciklusa. Ove kvalifikacije u Standardu broj 4., su date u formi bez obzira na koju se visokoškolsku ustanovu ili studijski program odnose.

Imajući to u vidu, „Referentni obrazovni standardi za hemiju i njoj srodne discipline" su definisani da bi odgovarali visokoškolskim institucijama i studijskim programima u kojima se realizuje Hemija i njoj srodne discipline, pri čemu sadržajno ne prelaze okvire definisane Standardom 4, koji je usvojen od strane Nacionalnog saveta i trenutno je važeći.

Na ovaj način definisanim standardima u okviru hemije i njoj srodnih disciplina, postigla bi se:

(i) međuinstitucionalna harmonizacija studijskih programa hemije u Srbiji,

(ii) harmonizacija sa evropskim studijskim programima hemije i

(iii) harmonizacija sa Eurobachelor, Euromaster i Eurodoctorate smernicama postavljenim za hemiju i njoj srodne discipline.

Usvajanjem ovako definisanih „Referentnih obrazovnih standarda za hemiju i njoj srodne discipline" biće omogućeno brže i jednostavnije definisanje svrhe, ciljeva i ishoda studijskih programa i predmeta u sledećem krugu akreditacije studijskih programa hemije.

dr Tatjana Anđelković, koordinator
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BENCHMARK STANDARDS FOR CHEMISTRY AND CHEMISTRY RELATED SUBJECTS

REFERENTNI OBRAZOVNI STANDARDI ZA HEMIJU I SRODNE DISCIPLINE

BENCHMARK STANDARDS FOR CHEMISTRY AND CHEMISTRY RELATED SUBJECTS

All students graduating with a degree in chemistry and chemistry related subjects are expected to demonstrate that they have acquired the knowledge, understanding, abilities and skills in the areas identified for foregoing degrees:

1. **First Cycle – Bachelor degree**

1.1 ***The following statements describe generally the threshold level of competence for holders of a bachelor's degree in chemistry and chemistry related subjects:***

- a basic knowledge and understanding of the content covered in the course is evident
- problems of a routine nature are, in general, adequately solved
- can work safely in the laboratory environment
- standard laboratory experiments can be carried out with reasonable success though the significance and limitations of the experimental data and/or observations may not be fully understood
- generic skills (for example: oral, written, numerical and IT) have been developed to a basic level.

1.2 The following statements describe the typical level of competence for holders of a bachelor's degree in chemistry and chemistry related subjects:

- knowledge base covers essential aspects of subject matter dealt with in the programme and shows some evidence of enquiry beyond this,
- good understanding of chemical concepts,

REFERENTNI OBRAZOVNI STANDARDI HEMIJA I SRODNE DISCIPLINE

Od svih studenata koji nameravaju da steknu neku od diploma iz oblasti hemije i srodnih disciplina očekuje se da pokažu da su stekli znanja, razumevanje, sposobnosti i veštine u oblastima definisanim za sledeće nivoe obrazovanja:

1. **Prvi stepen – Osnovne akademske studije**

1.1 Iskazi/zahtevi koji slede opisuju generalno bazični/početni nivo sposobnosti za one koji imaju završene osnovne akademske studije iz hemije i srodnih disciplina:

- Evidentna osnovna znanja i razumevanje sadržaja koji su obrađivani datim kursom,
- Adekvatno rešavanje problema od rutinskog značaja,
- Sposobnost da bezbedno radi u laboratorijskom okruženju,
- Može da izvodi standardne laboratorijske eksperimente sa zadovoljavajućim uspehom mada ne mora u potpunosti da razume i/ili sagleda važnost ili ograničenja eksperimentalnih rezultata/podataka,
- Opšte veštine (na primer: govorno, pismeno i numeričko izražavanje ili korišćenje informacionih tehnologija) razvijene na bazičnom nivou.

1.2 Iskazi/zahtevi koji slede opisuju generalno tipični/optimalni nivo sposobnosti za one koji imaju završene osnovne akademske studije iz hemije i srodnih disciplina:

- Posedovanje znanja koje obuhvata bitne aspekte predmetnog obrazovanja obuhvaćenog programom, a pred toga i pokazivanje interesa za istraživanje,
- Dobro razumevanje koncepata/pojmova u hemiji,
- Rešavanje poznatih problema na logičan način pri

- problems of a familiar nature are solved in a logical manner, and solutions are generally correct or acceptable,
- experimental work is carried out in a reliable and efficient manner,
- performance in generic skills is sound and shows no significant deficiencies,
- have a good grounding in the core areas of chemistry: inorganic, organic, physical, biological and analytical chemistry; and in addition the necessary background in mathematics and physics,
- have basic knowledge in several other more specialised areas of chemistry (for example forensic science, environmental chemistry, biochemistry, industrial chemistry, chemical technology, geochemistry and medicinal chemistry),
- have built up practical skills in chemistry during laboratory courses, at least in analytical, inorganic, organic and physical chemistry, in which they have worked individually or in groups as appropriate to the area,
- have developed generic skills in the context of chemistry which are applicable in many other contexts,
- have attained a standard of knowledge and competence which will give them access to second cycle course units or degree programmes.

The typical level should apply to the majority of graduates who consequently will possess the potential to progress to a master's degree programme in chemistry and chemistry related subjects.

2. **Second Cycle – Master degree**
2.1 The following statements describe the threshold level of competence for holders of a master's degree in chemistry and chemistry related subjects:

- knowledge base extends to a systematic understanding and critical awareness of topics which are informed by the forefront of the discipline,
- problems of an unfamiliar nature are tackled with appropriate methodology and taking into account the possible absence of complete data,

čemu su rešenja korektna i prihvatljiva,
- Eksperimenti se izvode na spretan i pouzdan način,
- Opšte veštine se ispunjavaju sigurno i ne pokazuju značajne nedostatke,
- Dobro je obučen u ključnim oblastima hemije: neorganske, organske, fizičke, analitičke hemije i biohemije, a dodatno ima podlogu iz matematike i fizike,
- Poseduje osnovna znanja i u nekoliko drugih, više specijalizovanih, oblasti hemije (na primer: forenzici, hemiji životne sredine, industrijskoj hemiji i hemijskoj tehnologiji, geohemiji i medicinskoj hemiji),
- Ima razvijene praktične veštine u oblasti hemije stečene na laboratorijskim praktikumima i to u neorganskoj, analitičkoj, organskoj i fizičkoj hemiji, gde se radilo individualno ii u grupama u skaldu sa potrebama naznačenih oblasti,
- Ima razvijene opšte veštine u oblasti hemije koje su ujedno upotrebljive i u drugim oblastima,
- Dostignuta standardna znanja i kompetencije otvaraju mogućnost da se student može upisati na studije drugog stepena.

Tipični/optimalni nivo sposobnosti treba da bude primenjiv na najveći broj studenata koji završavaju prvi stepen – osnovne akademske studije iz hemije i srodnih disciplina.

2. Drugi stepen – Master akademske studije
2.1 Iskazi/zahtevi koji slede opisuju generalno bazični/početni nivo sposobnosti za one koji imaju završene master akademske studije iz hemije i srodnih disciplina:

- Znanja koje obuhvata sistematsko razumevanje i kritičnu svest o temama koje su najnovije u datoj oblasti,
- Problemi koji mu nisu poznati rešava uz pomoć odgovarajućih metodologija imajući svest o mogućem nedostatku kompetentnih podataka,
- Eksperimente izvodi potpuno samostalno is a dozom originalnosti,
- Bitne istraživačke projekte koji su najnoviji u

- experimental work is carried out independently and with some originality,
- substantial research project at the forefront of the discipline is completed effectively,
- generic skills are developed appropriately for professional practice.

2.2 The following statements describe the typical level of competence for holders of a master's degrees in chemistry and chemistry related subjects:

- have knowledge and understanding that is founded upon and extends that of the Bachelor's level in chemistry, and that provides a basis for originality in developing and applying ideas within a research context,
- have competences which fit them for employment as professional chemists in chemical and related industries,
- have competences which fit them for employment as a teacher/lecturer in primary or secondary school education,
- have attained a standard of knowledge and competence which will give them access to third cycle course units or degree programmes.

3 Third cycle (doctoral) degrees in chemistry are awarded to students who:

3.1 The following statements describe the typical level of competence for holders of a PhD degree in chemistry:

- have demonstrated a systematic understanding of an aspect of the science of chemistry and mastery of those skills and methods of research associated with the topic of this research,
- have demonstrated the ability to conceive, design, implement and develop a substantial process of research in chemical sciences with rigor and integrity,
- have made a contribution through original research that extends the frontier of knowledge in chemical science by developing a substantial body of work, some of which merits national or international refereed publication,
- have competences which fit them for

datoj oblasti efikasno završava,
- Poseduje opšte veštine koje su razvijene za potrebe profesionalnog rada.

2.1 Iskazi/zahtevi koji slede opisuju generalno tipični/optimalni nivo sposobnosti za one koji imaju završene master akademske studije iz hemije i srodnih disciplina:

- Poseduje znanje i razumevanje koje se bazira, ali i prevazilazi, znanja karakteristična za nivo master akademskih studija iz hemije i srodnih disciplina što obezbeđuje sposobnosti za razvijanje i primenu ideja u oblasti istraživanja,
- Poseduje kompetencije koje odgovaraju potrebama prilikom zapošljavanja profesionalnih hemičara u hemijskoj i srodnoj proizvodnji/industriji,
- Poseduje kompetencije koje odgovaraju potrebama prilikom zapošljavanja kao nastavnika/predavača u osnovnim ili srednjim školama,
- Imaju dostignut nivo znanja i kompetencija koje otvaraju mogućnost da se student može upisati na studije trećeg stepena.

3. Treći stepen – Doktorske akademske studije
Diploma trećeg stepena (doktorat) u oblasti hemije dodeljuje se studetima koji:

3.1 Iskazi/zahtevi koji slede opisuju generalno tipični/optimalni nivo sposobnosti za one koji imaju završene doktorske akademske studije iz hemije i srodnih disciplina:

- Pokazuju sistematsko razumevanje određene uže oblasti hemijskih nauka i vladanje onim veštinama i metodama istraživanja vezanih za tu užu oblast istraživanja,
- Pokazuju sposobnost da shvataju, projektuju, primenjuju i razviju užu oblast istraživanja u hemijskoj nauci s punim integritetom i ozbiljnošću,
- Imaju naučne doprinose kroz originalna naučna istraživanja koja proširuju granice znanja u hemijskoj nauci, koja proističu iz znatnog sopstvenog rada i koja zadovoljavaju kriterijume nacionalnih i internacionalnih časopisa koji se citiraju,
- Poseduje kompetencije koje odgovaraju potrebama prilikom zapošljavanja profesionalnih hemičara na upravljačkim funkcijama u

employment as professional chemists in senior positions in chemical and related industries, or for a progression to a career in academic research,

- are capable of critical analysis, evaluation and synthesis of new and complex ideas,
- can communicate with peers, the larger scholar community and with society in general about the area of experience,
- can be expected to be able to promote, within the academic and professional context, scientific and technological advancement in a knowledge based society.

hemijskoj i srodnoj proizvodnji/industriji ili koje omogućavaju napredovanje u akademskim i istraživačkim sredinama,

- Sposobni su za kritičku analizu, ocenjivanje i sintezu novih i kompleksnih ideja,
- Mogu da komuniciraju sa sebi ravnima, sa većom akademskom zajednicom ili sa društvom uopšte na teme iz sopstvene oblast,
- Može se od njih očekivati da mogu da promovišu, u okvirima akademskog ili profesionalnog konteksta, naučna ili tehnička dostignuća u obrazovanim sredinama.