DIVISION of

NUCLEAR and RADIOCHEMISTRY

Application for the label

"EuroMaster in Nuclear and Radiochemistry"

(NRC EuroMaster)

"DNRC evaluation"

Date:	
Place:	

INTRODUCTION

EuroMaster in Nuclear and Radiochemistry (NRC EuroMaster) system was developed by CINCH (Cooperation in Nuclear Chemistry Education and Training in Europe) EU projects 2010-2016. The aim of the NRC EuroMaster system is to promote and harmonize NRC education in Europe and to promote and organize collaboration of European universities and student exchange. NRC EuroMaster system has two major components:

- Universities fulfilling minimum requirements are entitled to grant NRC EuroMaster label to their students.
- Universities having right to grant NRC EuroMaster label form a network to promote NRC education in Europe, mutual collaboration and student exchange.

The NRC EuroMaster label is granted to the universities by the Division of Nuclear and Radiochemistry of the European Association for Chemical and Molecular Sciences (DNRC EuCheMS). Based on the information given in this package by the candidate university the Division will evaluate the university's NRC curricula by comparing it to the minimum requirements defined in CINCH II project (Attachment 1). If the NRC curriculum fulfils the requirements by having at least 60 ECTS credit units workload in NRC and by covering at least 90% of the required compulsory topics the university will be given the right to grant NRC EuroMaster label to their NRC students and the university will become a member in the NRC EuroMaster Network.
The minimum requirements define that the master's program should contain at least 60 ECTS credit units (50% in case of 120 ECTS cu master's program) studies in nuclear and radiochemistry in the following way:

BSc in chemistry (first cycle)		180–240 cu[1]
Compulsory studies in nuclear and radiochemistry (of which at least 10 cu exercises)	minimum	25 cu
Optional studies in nuclear and radiochemistry	minimum	5 cu
Project work and Masters thesis in nuclear and radiochemistry	minimum	30 cu
Elective studies – rest up to the total due for the second cycle		rest
In total (second cycle)		90–120 cu[2]
In total		270–360 cu

For master's programs using other than ECTS credit unit system the workload of nuclear and radiochemistry studies should be equivalent to at least 60 ECTS credit units (1500 hours of students' work).

[1] "The framework of qualifications for the European Higher Education Area" adopted at The Bergen Conference of European Ministers Responsible for Higher Education, Bergen, Norway, 19-20 May 2005

[2] The Bologna Process - Conference on Master-level Degrees: Conclusions and Recommendations of the Conference. Helsinki, Finland, March 14 - 15, 2003

1 UNIVERSITY INFORMATION

Table 1: Information on the candidate university and NRC unit

University		
NRC unit (department, division, laboratory…)		
Address		
Home page		
Phone number		
Head of the NRC unit		
Number of employees (NRC unit)	Persons	Full time job equivalent
Professors		
Associate professors or equivalent		
Other Academic		
Researchers		
Technical		
Total		
Number of external teachers		
Average annual number of NRC master students		
Actual number of doctoral students	Full-time	Part-time

Comments:

2 STRUCTURE OF THE MASTER'S PROGRAM

The official title of your master's degree, such as Master in Chemistry, Master in Nuclear Chemistry, Master in Chemistry (specialization in radiochemistry) etc.:

Is your program accredited by any institution? Please, provide brief details.

Accredited (YES/NO)	
Institution	
Address	
Accredited for period	
Periodicity of re-accreditation	
First accreditation	
Programme running since	

If your university uses crediting system other than ECTS, please provide basic specification and its relation to the ECTS in the table below. Please, make the specification also in case that your bachelor and master's program have different credit volumes than those given in the introductory part (180, 120, and 300 cu).

Table 2: Specification of the crediting system used (fill only if ECTS is not used)

Specification:	
Required minimum number of credits defined above	
Bachelor programme	
Master programme	

Use the following tables to describe the contents of your NRC education both at bachelor and master's level. Modules are any study units (lecture course, laboratory course, thesis, seminar, examination, internship etc.) which have been defined in curricula and for which the number of credit units has been defined individually.

When filling the following tables, please use the instructions bellow:

- List all your bachelor- and master-level NRC modules here.
- In case you have a specific NRC bachelor program, mention it in the Table 3a and give a detailed description as an attachment
- Use the full names of the modules, as stated in your curricula (in English).
- Number your modules in the order of listing from 0 to *n* and use the respective abbreviations for your modules **B** – bachelor, **OB** – optional in bachelor, **C** – compulsory, **O** – optional, and **W** – project work as it is shown in the example.
- Please, create hypertext link for your module names to the English syllabi of the module . If it is not possible, please attach PDF of your syllabi to the application. The syllabi should follow the ECTS specifications (Appendix III to the Guidelines for Applications).
- Feel free to add rows to cover all your relevant modules
- If you use a non-ECTS crediting system or system with different credit volumes, replace "?" in the header of the last column by your unit defined in Table 2 and use this column.

Table 3a. NRC contents of your BSc programs.

Content	No.	Extent (cu)	Extent (?)
Curriculum at BSc level	***Total***	***180***	***or xx***
Compulsory studies in nuclear and radiochemistry	***Sum***		
Optional studies in nuclear and radiochemistry	***Sum***		

Comments:

Table 3b. NRC contents of your MSc programs.

Content	No.	Extent (cu)	Extent (?)
Curriculum at MSc level	***Total***	***120***	***or xx***
Compulsory studies in nuclear and radiochemistry	***Sum***		
Optional studies in nuclear and radiochemistry	***Sum***	***50***	
How many courses or credits are required? (Courses/Credits/Your unit)	(??)		

Comments:

Table 3c. NRC project works of your MSc programs.

Content	No.	Extent (cu)	Extent (?)
Project work and master's thesis in nuclear and radiochemistry	**Sum**		***or xx***

Comments:

3 NRC TOPICS COVERED IN YOUR CURRICULA – COMPULSORY STUDIES

Fill the Tables 4-9 to answer how the topics listed in Minimum requirements are covered in your bachelor or master's program. When filling the tables look for details in the Minimum requirements. **If necessary, add numbered comments bellow the tables**.

Table 4. Radioactivity, radionuclides and radiation – principles of nuclear physics to radiochemists. Module number from the list you gave in section 3 (Tables 3a-3c). In case the same topic is taught in more than one module, give numbers of all modules.

TOPIC	INCLUDED IN MODULE No.
structure of atom and nucleus, nucleons	
nuclides, radionuclides, isotopes, isobars	
types and origin of radionuclides	
factors affecting stability of nuclei	
modes of radioactive decay (fission, alpha decay, beta decay, internal transition)	
rate of radioactive decay, half-life, activity units, determination of half-lives	
activity concentrations vs. specific activity, activity vs. count rate	
equilibria in successive decay processes	
isotopic exchange - isotope effects	

Comments:

TOTAL EXTENT (estimate in credit units)	
- (estimated) extent in the lectures	
- (estimated) extent in the calculation exercises	
- (estimated) extent in the laboratory exercises	
- (estimated) extent in exams	
- (estimated) extent in seminars	
- (estimated) extent in others	

Table 5. Radiation safety

TOPIC	INCLUDED IN MODULE No.
types of radiation and their absorption processes by matter, range	
radiation safety measures and their units	
effects of radiation on DNA in cells	
health effects of radiation	
principles of radiation safety (justification, optimization, protection of individuals)	
radiation safety organizations and their recommendations and regulations	
estimation and measurement of radiation doses	
radiation safety practices, safe working habits in radionuclide laboratories and with radiation sources	
safe handling and disposal of radioactive waste from radionuclide laboratories	
measures during/after exceptional events	

Comments:

TOTAL EXTENT (estimate in credit units)	
- (estimated) extent in the lectures	
- (estimated) extent in the calculation exercises	
- (estimated) extent in the laboratory exercises	
- (estimated) extent in exams	
- (estimated) extent in seminars	
- (estimated) extent in others	

Table 6. Detection and measurement of radiation

TOPIC	INCLUDED IN MODULE No.
interaction processes of radiation with matter	
basic instrumentation in radiation measurements	
pulse counting vs. spectrometry	
pulse rate, counting efficiency, activity	
factors affecting counting efficiency	
energy resolution	
detectors for radiation measurement	
statistics and uncertainty calculations in radiometric measurements	
interpretation of gamma, alpha, beta and X-ray spectra	
energy and efficiency calibrations	
liquid scintillation counting	
radiation imaging	
background formation and subtraction	
quality control in radiation measurements	
mass spectrometric measurement of radionuclides	

Comments:

TOTAL EXTENT (estimate in credit units)	
- (estimated) extent in the lectures	
- (estimated) extent in the calculation exercises	
- (estimated) extent in the laboratory exercises	
- (estimated) extent in exams	
- (estimated) extent in seminars	
- (estimated) extent in others	

Table 7. Chemistry and analysis of radionuclides.

TOPIC	INCLUDED IN MODULE No.
chemistry (oxidation states, solubility, complex formation, hydrolysis, compounds) of the most important radionuclides	
nuclear characteristics (half-lives, decay modes, emitted radiation) of the most important radionuclides	
measurement techniques of the most important radionuclides	
special characteristics of the chemistry and separations of radionuclides	
needs and principles of radiochemical separations	
analytical methods used in radionuclide separations (precipitation, ion exchange, solvent extraction, extraction chromatography)	
yield determination and counting source preparations	
separation of long-lived radionuclides for mass spectrometric measurement	
sampling and sample pre-treatment methods	
speciation analysis of radionuclides	
hot-atom chemistry	

Comments:

TOTAL EXTENT (estimate in credit units)	
- (estimated) extent in the lectures	
- (estimated) extent in the calculation exercises	
- (estimated) extent in the laboratory exercises	
- (estimated) extent in exams	
- (estimated) extent in seminars	
- (estimated) extent in others	

Table 8. Nuclear reactions and production of radionuclides.

TOPIC	INCLUDED IN MODULE No.
interaction processes of particles with nuclei	
types of nuclear reactions and models	
coulombic barrier	
energetics of nuclear reactions	
kinetics of nuclear reactions	
cross-sections	
excitation functions	
induced fission	
types of particle accelerators	
production of radionuclides in cyclotrons	
production of radionuclides in reactors	
radionuclide generators	
principles and uses of nuclear power reactors	

Comments:

TOTAL EXTENT (estimate in credit units)	
- (estimated) extent in the lectures	
- (estimated) extent in the calculation exercises	
- (estimated) extent in the laboratory exercises	
- (estimated) extent in exams	
- (estimated) extent in seminars	
- (estimated) extent in others	

Table 8. Topics of NRC exercises.

TOPIC	INCLUDED IN MODULE No.
Calculation exercises	
use of nuclide chart and data bases	
calculation of activities based on half-life data	
calculation of activities in successive decays (radiochemical equilibria)	
calculation of irradiation yields based on cross sections and projectile flux	
calculation of irradiation doses	
calculation of required shielding for radiation protection	
uncertainty calculation in activity measurements	
conversion of count rates to activities	
Laboratory exercises	
detection of surface contamination for radiation safety	
use of radiation dosimeters for radiation safety to measure total dose and dose rates	
measurement of radiation with a simple detector, such as Geiger tube (e.g. dead-time, absorption of beta radiation, counting geometry etc.)	
measurement of radiation with a LSC	
measurement of radiation with a gamma spectrometer - energy calibration, interpretation of gamma spectra	
separations of radionuclides using various methods, such as precipitation/co-precipitation, ion exchange chromatography, solvent extraction and/or extraction chromatography	

Comments:

TOTAL EXTENT (estimate in credit units)	
- (estimated) extent in the calculation exercises	
- (estimated) extent in the laboratory exercises	

4 NRC TOPICS COVERED IN YOUR CURRICULA – OPTIONAL STUDIES

NRC curriculum should also include optional NRC studies in at minimum 5 cu. These course modules may cover various application fields of nuclear- and radiochemistry. Suggested topic areas are described below and detailed course contents in the Minimum requirements.

Topic areas for optional NRC courses/course modules suggested in Minimum requirements

Chemistry of the nuclear fuel cycle	TA1
Radiopharmaceutical chemistry	TA2
Environmental radioactivity – radioecology	TA3
Chemistry of actinides and transactinides	TA4
Chemistry of radionuclides in geosphere related to final disposal of spent nuclear fuel or high-level waste	TA5
Radiation chemistry	TA6
Nuclear and radioanalytical methods	TA7

What are the requirements of NRC optional studies in your curricula: how many modules and how many credit units are required?

- Please fill names of your studies including its extent in ECTS cu or your units defined in Table 2.
- When possible provide hyperlink to the syllabi or attach PDF of your syllabi to the application.
- For brief orientation, please use codes defined in the above table.

Table 9: Description and content of optional studies/modules in your curricula.

Name of the study, course, module etc.	Code No	Topic codes	Extent (cu)
(Name)			
		Total	
(Name)			
		Total	
(Name)			
		Total	
(Name)			
		Total	

Comments:

(Add lines into the previous table, if necessary.)

5 PROJECT WORK AND MASTER'S THESIS

Describe your master's thesis type (for example "Six months project including four months laboratory work and two months for writing the report on both experimental work and the literature" or "Three months laboratory work and report and an individual literature survey (two months)" or …).

How many credit unit you grant from project work and master's thesis. If there are several parts (see above) give credit units individually for each.

Give 4-6 examples of recent topics of projects works and master's thesis.

6 OTHER IMPORTANT INFORMATION

Please, provide any other important information about your NRC programme bellow. Also, if it is relevant provide information about accreditation of the programme.