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Applied Measurement Science

Master's Programme

www.ut.ee/ams

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Measurements?

- To be understood in the broadest sense:
  - Toxic metals in drinking water
  - Cholesterol level in blood
  - Strength of construction materials
  - Protein content in wheat
  - Octane number of gasoline
  - ...

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Importance of Measurements?

- Importance of measurements is enormous:
  - Critical decisions (economical, social, medical) are based on results of measurements
  - **40% of the EU directives** involve measurements
  - It has been estimated that direct spendings on measurements alone make up ca **80 billions of EUR or 1% of the GDP** in Europe
    - Adding in indirect costs raises this figure significantly

The Assessment of the Economic Role of Measurements and Testing in Modern Society. Survey directed by Geoffrey Williams, Pembroke College, Oxford, **2002**

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Why Study Measurement Science?

- Although important, it often happens that results of measurements are unacceptable:

Between 5 and 30 % of chemical measurements are unsatisfactory!

Metrology in Chemistry. Current Activities and Future Requirements in Europe. Prepared by B. King, EUR 19074 EN, Luxembourg, **1999**

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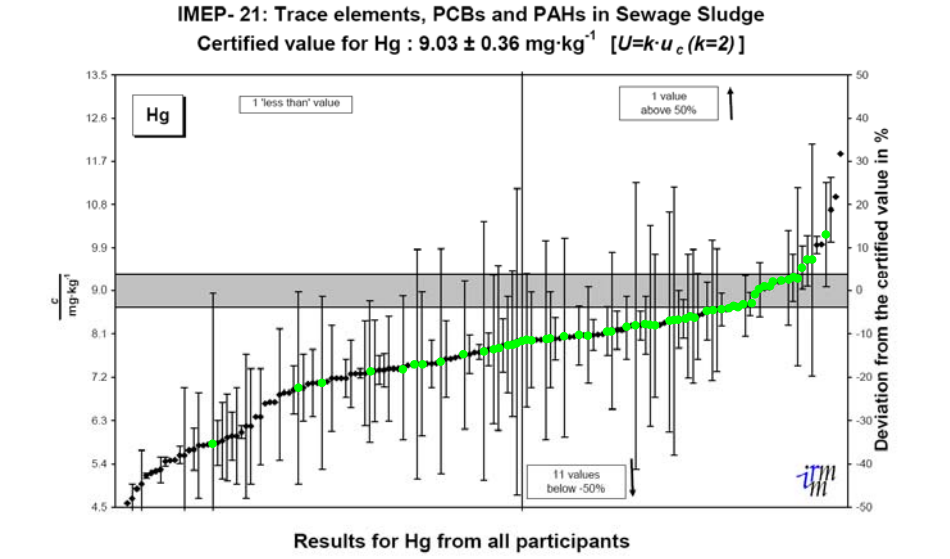

 http://www.irmm.jrc.be/imep/

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Key to success: Education

There is a huge need for educated workers and managers in laboratories!

This is why the AMS programme was launched

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Outline

- **Interdisciplinary** 3+2 master's degree programme
- **Cross-sectorial**
  - Physical measurements
  - Chemical measurements (chemical analyses)
  - Metrology
  - Quality systems
  - Economic and legal aspects of measurements
- Tuition in english

The education that you will get is of very broad applicability

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Knowledge and skills

- Measurement and analysis methods
  - Physical and chemical basis
- Factors affecting the results
- Calculation methods
- Knowledge necessary for assessment of quality of results
- Economic and legal aspects, quality systems

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Peculiarities of the programme

- International and interdisciplinary
  - Students with **different backgrounds**
  - Difficult to assemble course programs beforehand
    - Introductory tests
  - Some **levelling activities** may be necessary
- Some of the topics are still new to university programs
  - Harmonization underway

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From which countries the students come?

- Ukraine, China, Great Britain, Romania, Turkey, Latvia, Uzbekistan, Uganda, Jordan, Kasakhstan, Croatia, Albania, Lithuania, Sri Lanka, Malawi, Cameroon, Macedonia, Germany, India, Bangladesh, Nigeria, Portugal, Ghana, Greece

http://www.ut.ee/ams

Programme structure

Obligatory Module (45 ECTS)

Courses: Measuring and Instrumentation, Measurement Data Processing, Lab of Physical Measurements, Practical Chemical Analysis Methods, Lab of Chemical Analysis Methods, Fundamentals of Metrology, Metrology in Chemistry, Seminar in Measurement Science, Quality management

Elective Module (30 ECTS, courses can be chosen from the list)

Courses: Atomic Spectroscopy, Materials Characterization and Testing, Measurements in Biochemistry, Measurements and the Law, Economic Aspects of Measurements, Signal Processing, Chemometrics, Environment and Measurement, Electrochemical Measurement and Analysis Methods, Nanometrology, Quality Systems etc

Optional Subjects
(**6 ECTS**, any courses can be chosen university-wide)

Practical speciality training
(**9 ECTS**, internship placement in industry or analysis or calibration laboratories)

Master's thesis
(30 ECTS, reasearch project with a topic related to measurement science**)**

https://www.is.ut.ee/pls/ois/tere.tulemast?viit=4562228

Applied Measurement Science (120 ECTS) print XLS		
1. Obligatory subjects (45 ECTS) "and"		Show module's objectives
LOKT.06.036	Master Seminar in Measurement Science (12 ECTS)	
LOFY.01.039	Measurement Data Processing (3 ECTS)	
LOFY.01.036	Measuring and Instrumentation (3 ECTS)	
LOKT.06.030	Metrology in Chemistry (6 ECTS)	
LOFY.01.037	Modern Metrology (3 ECTS)	
LOKT.06.032	Practical Chemical Analysis (6 ECTS)	
LOKT.06.033	Practical Works in Chemical Analysis and Metrology (6 ECTS)	
LOFY.01.040	Practical Works on Physical Measurement and Calibration (3 ECTS)	
LOFY.01.082	Quality Management (3 ECTS)	
2. Elective subjects (30 ECTS) "and"		Show module's objectives
LOKT.06.047	Atomic Spectroscopy (3 ECTS)	
LOKT.06.043	Bridging course in chemistry (3 ECTS)	
LOKT.08.005	Chemometrics (6 ECTS)	
MJRI.10.037	Economic Aspects of Measurements (3 ECTS)	
LOKT.02.035	Electrochemical Methods for Quantitative Analysis (3 ECTS)	
LOKT.06.018	English Terminology in Chemistry (6 ECTS)	
LOKT.04.072	Environment and Measurement (3 ECTS)	
LOKT.06.016	Liquid Chromatography and Mass Spectrometry (6 ECTS)	
LOFY.05.051	Master Course in Biological Physics (3 ECTS)	
LOKT.01.063	Materials characterization and testing methods in chemistry (6 ECTS)	
LOKT.06.039	Measurement Science in Chemistry Summer School (12 ECTS)	
LOKT.06.034	Measurements and the Law (3 ECTS)	
LOKT.10.017	Measurements in Biochemistry (3 ECTS)	
LOFY.01.096	Nanometrology (3 ECTS)	
LOFY.03.038	Nuclear Engineering (6 ECTS)	
LOFY.03.062	Nuclear reactor physics (6 ECTS)	
LOFY.01.098	Project and Quality Management (3 ECTS)	
LOKT.09.028	Quality Systems (3 ECTS)	
LOFY.01.020	Signal Processing (3 ECTS)	
LOKT.09.022	Structural Analysis I (3 ECTS)	
3. Optional subjects (6 ECTS) "or"		Show module's objectives
4. Practical speciality training (9 ECTS) "and"		Show module's objectives
LOKT.00.017	Practical Speciality Training (9 ECTS)	
5. Master´s thesis (30 ECTS) "and"		Show module's objectives
LOKT.00.002	Master's Thesis (30 ECTS)	

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Timetable, autumn 2014 (1)

Time	Course code	Course title	Location	Week(s)	Group(s)	Lecturer(s)
Monday						
12.15 - 14.00	LOKT.06.016	Liquid Chromatography and Mass Spectrometry (lecture)	Ravila 14A - 1100	2-11,15-16		Ivo Leito, Koit Herodes, Karin Kipper, Anneli Kruve
13.15 - 19.00	LOKT.06.047	Atomic Spectroscopy (lecture)	Ravila 14A - 1100	12-13		Teemu Matias Näykki, Ivo Leito
Tuesday						
10.15 - 16.00	LOKT.06.047	Atomic Spectroscopy (lecture)	Ravila 14A - 1051	12-13		Teemu Matias Näykki, Ivo Leito
14.15 - 16.00	LOKT.06.016	Liquid Chromatography and Mass Spectrometry (lecture)	Ravila 14A - 1051	1-11,14-16		Ivo Leito, Koit Herodes, Karin Kipper, Anneli Kruve
Wednesday						
8.15 - 10.00	LOFY.01.036	Measuring and Instrumentation (lecture)	Ravila 14c - A102	1-16		Koit Mauring
10.15 - 12.00	LOKT.06.018	English Terminology in Chemistry (lecture)	Ravila 14A - 1021	1-16		Ivo Leito, Koit Herodes
12.15 - 14.00	LOKT.06.032	Practical Chemical Analysis (lecture)	Ravila 14A - 1100	1-16		Koit Herodes, Ivo Leito
14.15 - 16.00	LOKT.09.022	Structural Analysis I (lecture)	Ravila 14A - 3070	1-16		Uno Mäeorg
14.15 - 16.00	LOFY.01.082	Quality Management (lecture)	Ravila 14c - A102	2-16		Mart Noorma
16.15 - 18.00	LOKT.06.036	Master Seminar in Measurement Science (seminar)	Ravila 14A - 1100	2 1-16		Ivo Leito

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Timetable, autumn 2014 (2)

8.15 - 10.00	LOFY.01.039	Measurement Data Processing (lecture)	Ravila 14c - A102	1,3-16		Erko Jakobson
10.15 - 12.00	LOFY.01.039	Measurement Data Processing (lecture)	Ravila 14c - A111	1		Erko Jakobson
10.15 - 12.00	LOFY.01.037	Modern Metrology (lecture)	Ravila 14c - A111	2-16		Mart Noorma, Martin Vilbaste, Riho Vendt
12.15 - 14.00	LOKT.09.028	Quality Systems (lecture)	Ravila 14A - 1019	3-16		Jukka Veli Hiltunen
Friday						
12.15 - 14.00	LOKT.06.032	Practical Chemical Analysis (lecture)	Ravila 14A - 1100	1-16		Koit Herodes, Ivo Leito
14.15 - 16.00	LOKT.02.035	Electrochemical Methods for Quantitative Analysis (lecture)	Ravila 14A - 1100	1-16		Jaanus Kruusma

- Obligatory course

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Other study activities

- **Practical placement** in industry or field laboratory (9 ECTS)
- **Optional subjects** (6 ECTS)
- **Master's thesis** (30 ECTS)
  - Research work in a research group
  - Must be at least "potentially publishable", preferably published or submitted by defence
- **MSC Euromaster**
  - At the end of this presentation …

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Study progress requirements

- The overall programme is 120 ECTS
- **Per semester** you should get
  - **preferably 30 ECTS**
  - **as a minimum 24 ECTS**
  - The acconting is cumulative
    - See http://www.ut.ee/ams/tuition-fees-scholarships/
- In the case of extensive previous experience **credit transfer** (VÕTA) is possible
  - This is dealt with on case by case basis

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Locations of teaching

- (New) Chemistry building “Chemicum” Ravila 14a

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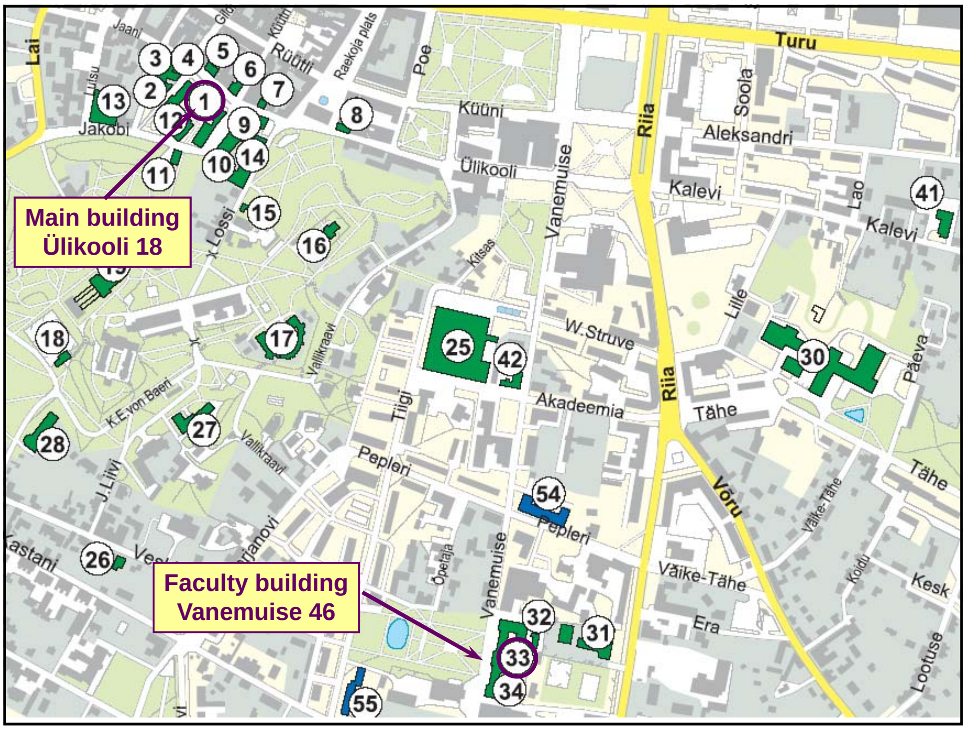
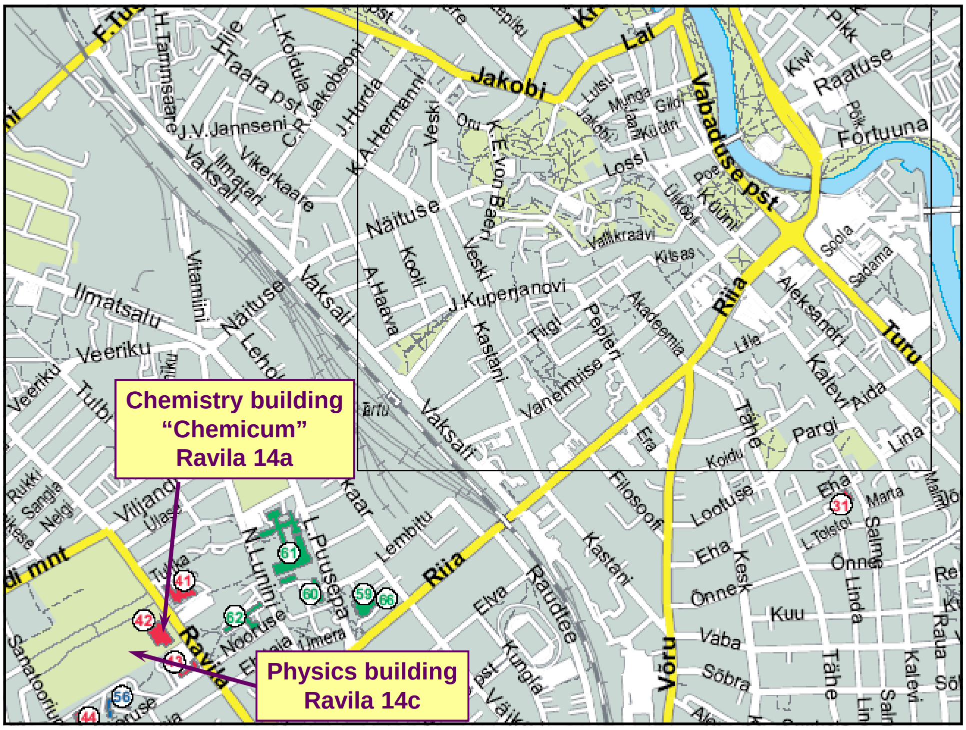
Locations of teaching

- Physics building Ravila 14c


Main building
Ülikooli 18
Faculty building
Vanemuise 46
Turu
Riia
Võru
Vanemuise
Akadeemia
Pepleri
Küüni
Ülikooli
Aleksandri
Kalevi
Lai
Jakobi
Tähe
W.Struve
Väike-Tähe
Era
Poe
Soola
Lao
Lille
Päeva
Tiigi
Kesk
Lootuse
Vallikraavi
K.E.von Baeri
J.Liivi
Kastani
Raekoja plats
Rüütli


Chemistry building
“Chemicum”
Ravila 14a
Physics building
Ravila 14c
Jakobi
Lai
Vabaduse pst
Riia
Võru
Turu
Vaksali
Näituse
Ravila
Raudtee
Kastani
Filosoofi
Lootuse
Vanemuise
Pepleri
Akadeemia
Aleksandri
Kalevi
Tähe
Veeriku
Ilmatsalu
Vitamiini
Tulbi
Viljandi
Riia
Lembitu
Elva
Kuu
Vaba
Sõbra
Pargi
Aida
Raatuse
Fortuuna

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Programme Coordination and Development

- **Ivo Leito**, prof, programme development
  - ivo.leito@ut.ee, +372 5 184 176, Skype: leitoivo, Ravila 14a - 4034

– Study-programme-related questions

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Programme administration

- **Urve Soonets**, programme coordinator assistant
  - Urve.soonets@ut.ee, Ravila 14c

– Study-administrative questions

– Chemicum

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International student office

Kaija Murasov, International student coordinator

- Kaija.murasov@ut.ee,
  +372 7 375 152,
  Ülikooli 18 – 104

– Problems not directly related to the study programme

- Visa, Residence permit, Health insurance, Dormitory, …

– Ülikooli 18
The "main building":

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Stipends/Scholarships

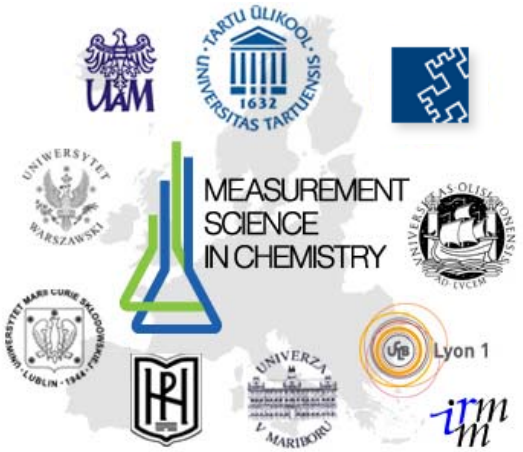
http://www.ut.ee/ams/tuition-fees-scholarships/

- Tuition fee waiver Scholarships
  - **Most of you have got it**
- ERC Stipends (up to 300 EUR/month)
  - **Decided by your supervisor, contact him/her**
- DoRa stipends

Measurement Science in Chemistry

www.msc-euromaster.eu

- International consortium
- 8 countries
  - Estonia, Slovenia, Bulgaria, France, Portugal, Poland, Finland, Belgium
- 10 universities



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Euromaster Quality label

- In 2008 ECTNA Euromaster® quality label was awarded to **Measurement science in chemistry** Consortium

European Chemistry Thematic Network
ECTN
European Chemistry Thematic Network Association
EUROMASTER

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What is in it for you?

- You can apply for a study place
  - It is for the best students
  - Number of places is limited
- You will get
  - Advanced training in an international **summer school** by leading European experts
  - An additional **Euromaster diploma supplement** after graduation

MEASUREMENT SCIENCE IN CHEMISTRY

EUROMASTER CERTIFICATE OF COMPLETION

Annex to Diploma No

This is to certify that

ANABELA DE JESUS LOBO DA COSTA

(born in 17.01.1985) has successfully completed THE PAN-CONSORTIUM INTENSIVE COURSE (SUMMER SCHOOL 2008), which together with the master's programme in Mestrado em Química Analítica (Master of Science in Analytical Chemistry) constitute the jointly delivered master's programme – Euromaster in Measurement Science in Chemistry.

This certificate is issued by the University of Tartu on behalf of the international consortium „Measurement Science in Chemistry".

7-2/LO-581-H

1/5

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Summer school content

- Validation of chemical analysis procedures
- Basic statistics, Statistical basis of calibration
- Traceability in chemical analysis
- Alternative Approaches for the Quantification of Measurement Uncertainty
- ISO 17025, Accreditation visit to real lab
- Sampling and sample preparation in food and environmental analysis
- Customer-analyst interactions
- Importance of reliable measurements to implement EU legislation

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MSC Summer school

- Summer 2009 Blagoevgrad (Bulgaria)
  - 43 participants, 9 countries
- Summer 2010 Lepanina (Estonia)
  - 39 participants, 9 countries
- Summer 2011 Poznañ (Poland)
  - 43 participants, 13 countries
- Summer 2012 Fatima (Portugal)
  - 48 participants, 13 countries
- Summer 2013 Lyon (France)
  - 34 participants, 10 countries
- Summer 2014 Casablanca (Morocco) Jul 27 – Aug 9