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Applied Measurement Science

Master's Programme

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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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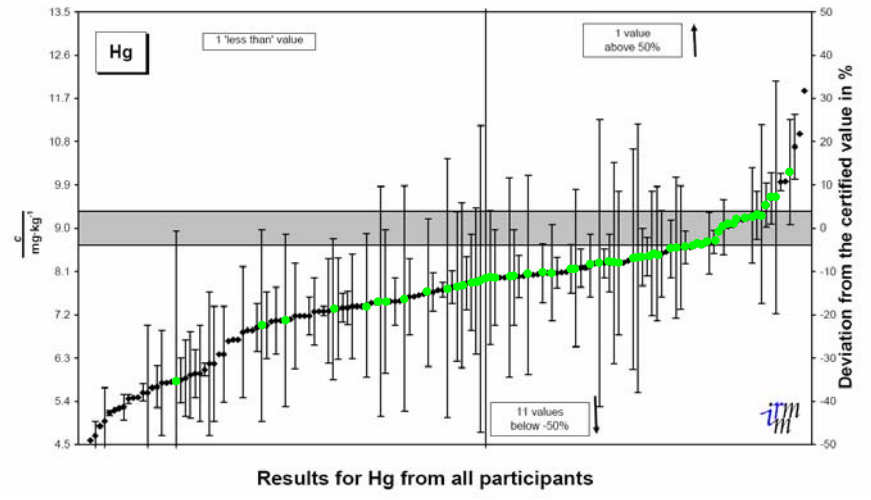
IMEP- 21: Trace elements, PCBs and PAHs in Sewage Sludge
Certified value for Hg : 9.03 ± 0.36 mg·kg^{-1} [$U=k\cdot u_c$ ($k=2$)]



Results for Hg from all participants

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

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: Materials Characterization and Testing, Structural Analysis, 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)

Internship
(**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_sso/tere.tulemast?viit=2194243

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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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Obligatory subjects (courses)

Course	Code	ECTS	Lect/Sem /Lab	Comments
Measuring and Instrumentation	LOFY.01.036	3	Lect	Core lecture course on physical measurements (physical basis of measurement methods)
Measurement Data Processing	LOFY.01.039	3	Lect	Core lecture course on measurement-related data processing (mathematical statistics, distribution functions, measurement uncertainty, etc)
Practical Chemical Analysis	LOKT.06.032	6	Lect, Seminar	Core lecture course on chemical analysis (Physical and chemical principles of the main classical and instrumental methods of chemical analysis, calculations in analytical chemistry)
Fundamentals of Metrology	LOKT.06.031	3	Lect	Core lecture course on general and physical metrology
Quality Management	LOFY.01.082	3	Lect	Lecture course on quality systems (ISO 17025, ISO 9001)
Master Seminar in Measuremnt Science	LOKT.06.036	12 (3)	Seminar	Seminar (work with literature, presentations, monitoring the progress of master thesis)
Practical physical measurements and calibrations	LOFY.01.040	3	Lab	Core lab course on physical measurements
Practical Works in Chemical Analysis and Metrology	LOKT.06.033	6	Lab	Core lab course on chemical analysis
Metrology in Chemistry	LOKT.06.030	6	Lect, Comput. lab	Core lecture course on metrology in chemistry (method validation, traceability, reference materials, measurement uncertainty in chemistry, …)

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Elective subjects (courses)

Course	Code	ECTS	Lect/Sem /Lab	Comments
Materials characterization and testing methods in chemistry	LOKT.01.063	6	Lect, lab	Classical and modern (SEM, STM, AFM) methods of materials testing
Electrochemical Methods for Quantitative Analysis	LOKT.02.035	3	Lect, lab	Measurement science in electrochemistry
Measurements and the Law	LOKT.06.034	3	Lect	Legal aspects of measurements
Economic aspects of measurements	LOKT.06.035	3	Lect	Economic impact of measurements
Signal Processing	LOFY.01.020	3	Lect	Mathematics and algorithms for processing of measurement signals
Environment and Measurement	LOKT.04.072	3	Lect, Lab	Environmental applications of measurements
Measurements in Biochemistry	LOKT.10.017	3	Lect, Lab	Biochemical applications of measurements
Structural Analysis I	LOKT.09.022	3	Lect, Lab	Instrumental methods for determining molecular structure
Chemometrics	LOKT.08.005	3	Lect	Advanced data processing in science, especially in analytical chemistry
Nanometrology	LOFY.01.096	3	Lect	Measurements at nanometer level
Quality systems	LOKT.09.028	3	Lect	Lecture course on quality systems (ISO 17025, GLP)
Mechanical Behavior of Materials	LOFY.03.037	6	Lect	Mechanical properties of materials and their testing and measurement
Nuclear Engineering	LOFY.03.038	6	Lect	Introduction to nuclear processes and radiation, nuclear reactors and energetics, nuclear safety

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Autumn 2011 Timetable (obligatory)

Time	Course code	Course title	Place	Comments	Lecturers
Wednesday					
8.15 - 10.00	LOFY.01.036	Measuring and Instrumentation (lecture)	Tähe 4 - 411	Compulsory Start: 31.08	Koit Mauring
10.15 - 12.00	LOFY.01.082	Quality management (lecture/seminar)	Tähe 4 – 427 or 111	Compulsory Start: 31.08	Mart Noorma
12.15 – 14.00	LOKT.06.032	Practical Chemical Analysis (lecture)	Ravila 14A – 1100	Compulsory Start: 31.08	Koit Herodes, Ivo Leito
16.15 – 18.00	LOKT.06.036	Master Seminar in Measurement Science (seminar)	Ravila 14A – 1100	Compulsory Start: 31.08	Ivo Leito
Thursday					
10.15 – 12.00	LOKT.06.031	Fundamentals of Metrology (lecture)	Tähe 4 - 427	Compulsory Start: 08.09	Riho Vendt, Toomas Kübarsepp, Viktor Vabson
Friday					
10.15 – 12.00	LOFY.01.039	Measurement Data Processing (lecture/seminar)	Tähe 4 - 427	Compulsory Start: 02.09	Erko Jakobson
12.15 – 14.00	LOKT.06.032	Practical Chemical Analysis (lecture)	Ravila 14A – 1100	Compulsory	Koit Herodes, Ivo Leito

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Autumn 2011 Timetable (elective)

Time	Course code	Course title	Place	Comments	Lecturers
Tuesday					
Wednesday					
14.15 - 16.00	LOKT.09.022	Structural Analysis I (lecture and practice learning)	Ravila 14A – 1100	Elective Start: 31.08	Uno Mäeorg, Sirje Mäeorg
Thursday					
14.15 – 16.00	LOKT.09.028	Quality Systems (lecture)	Ravila 14A – 1020	Elective Start 08.09	Jukka Veli Hiltunen
16.15 – 18.00	LOKT.01.063	Materials characterization and testing methods in chemistry	Riia mnt 142 – 301	Elective Start:08.09	Väino Sammelselg
Friday					
14.15 – 16.00	LOKT.02.035	Electrochemical Methods for Quantitative Analysis (lecture)	Ravila 14A – 1100	Elective Start: 02.09	Jaanus Kruusma
16.15 – 18.00	LOKT.01.063	Materials characterization and testing methods in chemistry	Riia mnt 142 – 301	Elective	Väino Sammelselg

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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 Information System (SIS)

- Address: **http://ois.ut.ee/**
- The administration of your studies proceeds fully via SIS
- The username and password of SIS are also used for accessing most other data systems here at UT
- Please monitor your e-mail account

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Taking a course, what does it mean?

1. Registering to the course via SIS
2. Attending the course
   - Performing intermediate tests, answering questions on practical works, if required, etc
3. Registering to the exam via SIS
4. Taking the exam
   - In some courses (labs) there are no exams

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Study progress requirements

- The overall programme is 120 ECTS
- **Per semester** you should get
  - **preferably 30 ECTS**
  - **as a minimum 22.5 ECTS**
  - The acconting is cumulative
- 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
  Tähe 4

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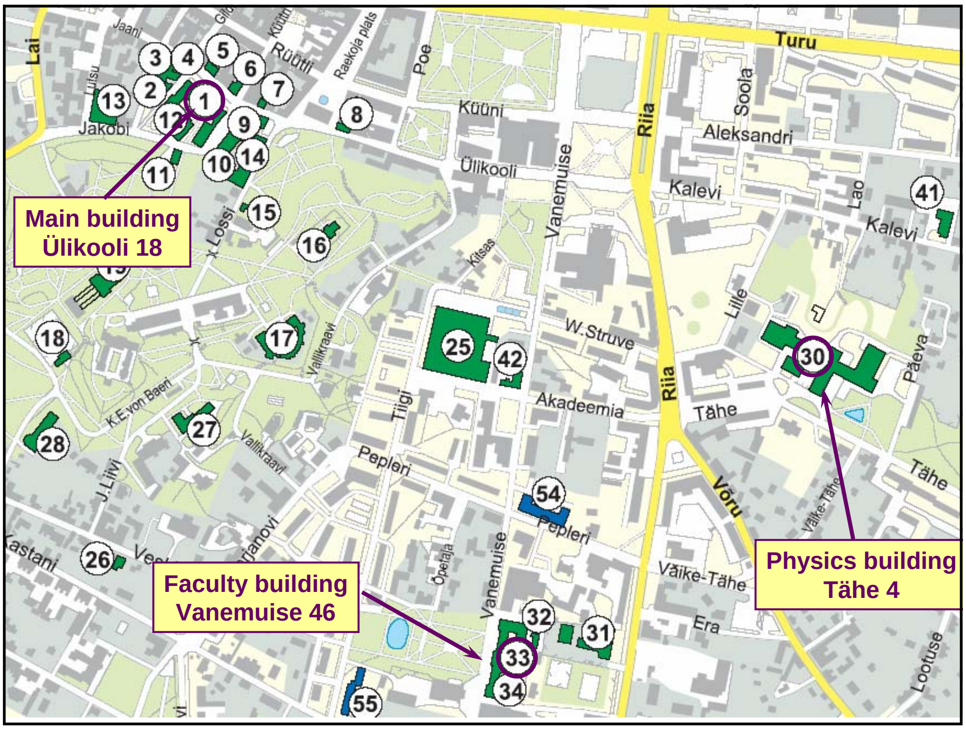
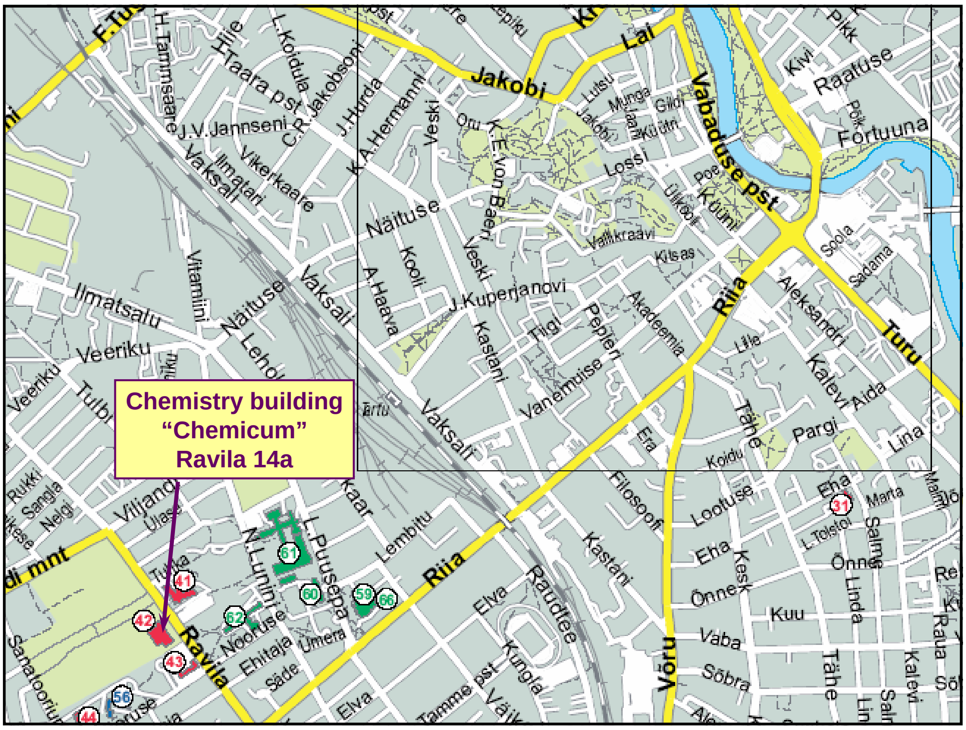
Locations of teaching

- Physics building (“Institute of physics”)
  Riia 142


Main building
Ülikooli 18
Faculty building
Vanemuise 46
Physics building
Tähe 4
Turu
Riia
Võru
Vanemuise
Küüni
Ülikooli
Kalevi
Aleksandri
Akadeemia
Pepleri
W.Struve
Tähe
Väike-Tähe
Era
Lootuse
Jakobi
Rüütli
Lossi
Poe
Soola
Tiigi
Lai


Chemistry building
“Chemicum”
Ravila 14a
Jakobi
Lai
Vabaduse pst
Riia
Võru
Turu
Ravila
Vaksali
Näituse
Kastani
Vanemuise
Aleksandri
Kalevi
Filosoofi
Lootuse
Raudtee
Elva
Kuu
Vaba
Sõbra
Tähe
Fortuuna
Raatuse
Lembitu
Veeriku

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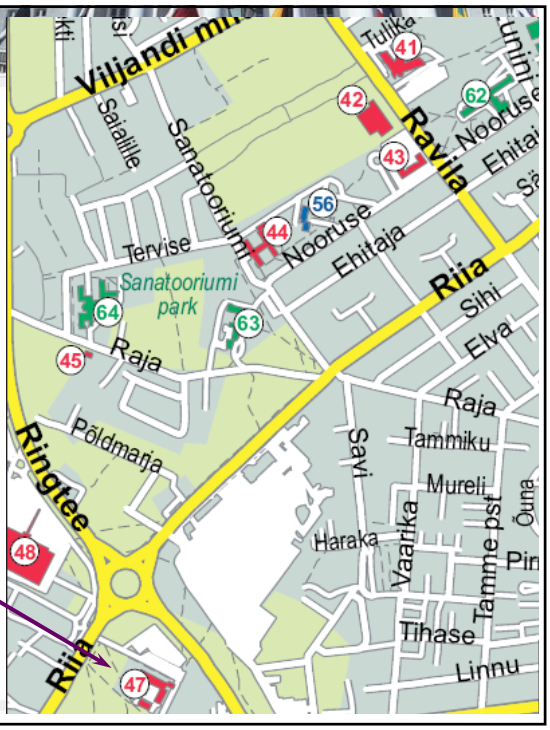

Physics building (Institute of Physica) Riia 142

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Access to the Chemistry Building form the Centre

- Bus No 5
- Stop “Nooruse”
- Info at http://www.peatus.ee/#route_search/eng

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Program Coordination

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

  - Study-program-related questions
    - Choosing courses
    - Taking into account previous experience
    - Etc…

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Program Coordination

- **Sergei Jurtšenko**, helper of programme director
  - sergei.yurchenko@mail.ee +372 5 380 6760

  - Hopefully will become programme director soon
  - Study-program-related questions
    - Choosing courses
    - Taking into account previous experience
    - Etc…

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Dean's office

- **Imbi Rauk**, student advisor
  - Imbi.rauk@ut.ee, +372 7 375 829, Vanemuise 46 – 208

– Study-administrative questions

– Building at Vanemuise 46:

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International student office

- **Piret Pumm**, International student coordinator
  - piret.pumm@ut.ee, +372 7 375 152, Ülikooli 18 – 104

– Problems not directly related to the study program
  - Visa, Residence permit, Healt insurance, Dormitory, …

– Ülikooli 18 The "main building":

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Tutors

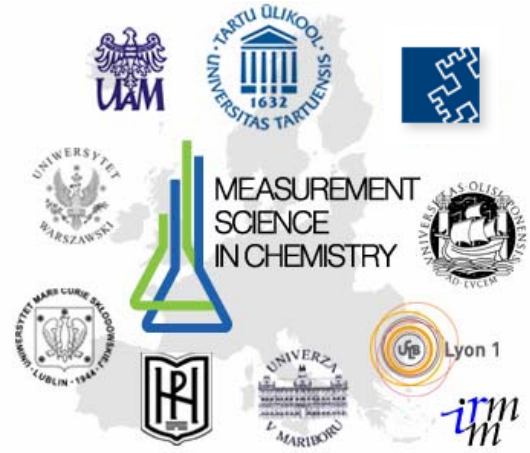
- Kelli Tikerpuu
  - kellii@hot.ee, +372 53 402 560
- Kerttu Sobak
  - kerttusobak@gmail.com, +372 55 605 316

– Questions about everyday student-life

Measurement Science in Chemistry

www.msc-euromaster.eu

- International consortium
- 7 countries
  - Estonia, Slovenia, Bulgaria, France, Portugal, Poland, Finland
- 9 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".

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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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Summer schools

- 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)

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Stipends/Scholarships

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

- Tuition fee waiver Scholarships
  - **You all have got it!**
- Monthly stipend for the best (up to 255 EUR/month)
  - **According to study results (no application needed)**
- ESF Stipends (up to 300 EUR/month)
  - **Decided by your supervisor, contact him/her**
- Government stipends (ca 50 EUR/month)
  - **Possible from 2. semester, application via SIS**
- "DoRa 9″ Stipends