EK2360 Hands-On Microelectro-mechanical Systems Engineer-ing 7.5 credits

Projektkurs i mikrosystemteknik

This is a translation of the Swedish, legally binding, course syllabus.

Establishment

Course syllabus for EK2360 valid from Spring 2019

Grading scale

A, B, C, D, E, FX, F

Education cycle

Second cycle

Main field of study

Electrical Engineering

Specific prerequisites

For single course students: 120 credits and documented proficiency in English B or equiva-lent

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

During the course, the student will gain in-depth knowledge and understanding on microsystems, with emphasis on different micro-electromechanical actuator types, on their working principles, concept and design, process technology, clean-room fabrication, device characterization, and failure analysis. Upon successfully completing the course, the student will be able to:

- develop different concepts of microsystem actuators for real-world applications

- design microsystem devices and adapt them to different application requirements

- predict the behaviour of microsystem devices by (1) qualified guessing based on general understanding of the microsystem and the application; (2) rough estimation by using/adapting text book formulas; (3) accurate modelling and simulating by modelling using state-of-the-art multi-physics finite-element based design tools (FEM)

- work out design concepts under consideration of fabrication-technology limitations

- develop a fabrication process flow

- carry out basic microsystem fabrication steps in a class-100 clean-room environment under the safety requirements of such an environment

- characterize the devices for their electrical, mechanical, and thermal behaviour

- identify failure mechanisms, conclude on device limitations and reflect on device improvements based on the characterization results of the prototype devices

- write a project report summarizing design, fabrication, characterization, failure analysis, and potential future device improvements

- present and defend the results to a critical audience

- work in a small microsystem development team, including taking management responsibility from project plan writing to work distribution and task assignment to the team members

Course contents

EK2360 is a project course worth 7.5 ECTS credits, which is equivalent to 200 work hours of full-time study. As the course runs about 8 weeks, this implies that about 25 hours a week must be devoted to various course activities, including introductory lectures and reading of course material, together comprising about 20% of the course activities, and carrying out the project work, which comprises 80% of the course work.

The introductory lectures on basic MEMS design and fabrication, with special focus on the following project work, will be taught by the course responsible. Attendance of the introductory lectures is compulsory.

After the introductory lectures, a brief written intermediate examination will be carried out, assessing whether the knowledge and understanding of the student is sufficient for continuing with the actual project work.

The project work is supervised by senior PhD students and the course responsible.

The report writing and the final presentation and a brief post-discussion are supervised by the course responsible.

Course literature

Nödvändig kurslitteratur kommer att distribueras under kursen.

PDF-versioner av de inledande föreläsningsbilderna kommer att göras tillgängliga i förväg genom BILDA och är obligatorisk läsning före respektive föreläsning

För ytterligare läsning, särskilt för studenter med begränsade förkunskaper inom MEMS, rekommenderas följande böcker (ett begränsat antal exemplar finns tillgängliga för kursdeltagare hos Mikrosystemteknik, och kan också finnas på KTH-biblioteket):

- Marc J. Madou, **Fundamentals of Microfabrication: The Science of Miniaturization,** CRC, 2:a upplagan (13 mars 2002), ISBN-10: 0849308267, ISBN-13: 978-0849308260

- Gregory T. Kovacs, **Micromachined Transducers Sourcebook**, McGraw-Hill, 1:a upplagan (1 februari 1998), ISBN-10: 0072907223, ISBN-13: 978-0072907223

- Sami Franssila, **Introduction to Microfabrication**, Wiley, 1:a upplagan (14 juni 2004), ISBN-10: 0470851066, ISBN-13: 978-0470851067

Examination

• PRO1 - Project, 7.5 credits, grading scale: A, B, C, D, E, FX, F

Based on recommendation from KTH's coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

If the course is discontinued, students may request to be examined during the following two academic years.

Other requirements for final grade

The student's final grade in the course will be based on

- attendance of the introductory lectures (pass/fail criteria)

- performance on an intermediate assessment inform of a written examination test after the introductory lecture. The examination will test the student's overall comprehension of the various topics covered in the lectures. It will mainly be used as a pass/fail criteria for the student being allowed to carry on with the practical course part, but will also be used to influence the of final mark (10%)

- project work: overall evaluation of the project work of the project team as a whole, including the project report and the final project presentation to a critical audience, adding up to 90% of the final mark. Individual adjustments might be done. Criteria for the evaluation of project work, report, and presentation will be communicated before the start of the actual project work. The grading of the project work is given independent on the outcome of the student competition. The summary of the expected device performance after the design phase (see previous section) will not be used for determining the grade.

- after the presentation, the course responsible will have a short discussion with the individual student teams, which might be used for adjusting the final mark of the teams and of the individuals

The course is worth 7.5 ECTS points; grading will be on a scale from A to F, with A being the highest mark and E being the lowest mark for passing the course, and F being a failing mark.

Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.