Course Plan Autumn 2021 version 2

Project Carrier Course for Medical Engineers, part 1 (CM2015)

Welcome to the Project Carrier Course, part 1 (PCC1)!
Here you find all information you need for the course.

Course information

Number of credits: 15 credits (HP)
Grading scale: A, B, C, D, E, FX, F

Contact information

- Martin Jacobsson, martin.jacobsson@sth.kth.se, room 6306, examiner
- Massimiliano Colarieti-Tosti, mct@kth.se
- Philip Köck, koeck@kth.se

Course Content

The course main goal is to train medical engineering students in planning, documenting, and communicate the results of engineering projects. Students will be requested and trained both in applying relevant tools for making sound quantitative or qualitative analysis but also in more practical engineering activities. Further, the course aims at training our students in considering both sustainability and ethical aspects when exercising their profession.

This course adopts a practical, *hands-on* approach and will enhance all your engineering skills. This will be done by a series of laboratory exercises and two larger projects. The labs are designed to develop the necessary engineering skills for successfully carrying out the later projects in PCC1, but also in the successive project-carrier courses in the programme.

Course literature

This course has no recommended course literature. Students are expected to find and use relevant material in order to complete their tasks and projects. We will provide pointers to online material that will help the students in their work.

Course Content

Lectures (tentative)

- L1 (Tue 31 Aug), T4, **Introduction**, Martin, Mamo, Filip
- L2 (Mon 6 Sep), Zoom, **PCB Design, Analog electronics, filter design**, Martin, Linus??
- ~~L3 (Mon 11 Oct), T4, ??~~
- L4 (Tue 12 Oct), T4, **Project Planning and Group Dynamics**, ??
- L5 (Wed 3 Nov), T3, **Introduction Flavour-based project**, Martin
- L6 (Fri 26 Nov), T3, **Introduction Track-based project**, Martin

Labs

All labs are done in pairs. You will be assigned a lab partner by us in Canvas.

Lab 1: Programming of a wireless sensor.

Dates: Sep 1-3

Task: The task is to make a complete system consisting of an analog medical sensor, data acquisition, communications, and rudimentary data processing and presentation. You will borrow Micro:Bit hardware and some other hardware. We will start in the computer lab, but you can complete the work at a later time.

Examination: The lab is examined by handing in the solution and demo it to the teacher/assistant.

Lab 2: PCB-design

Dates: Sep 10

Task: Use KiCAD to design a PCB for a given circuit. This task can be carried out at home. On Sep 10, there is a booked time slot that can be used.

Examination: Hand in the final solution in Canvas.

Lab 3: Soldering exercise

Dates: no given dates

Task: Solder all the components for the circuit design in lab 2. This can be done in the MakerSpace at your own pace. No time is booked for this exercise. Our MakerSpace manager Linus will be able to assist you if needed.

Examination: Demonstrate that the PCB works as expected for a teacher/assistant.

Lab 4: Make a signal generator

Dates: Sep 13,15,16

Task: Using a Micro:Bit, generate an electrical signal that mimics a real heart PPG signal. The user should easily be able to select the generated heart rate. This task involves both programming the Micro:bit and analog electronics. You need to make an analog low pass filter. The final solution should be soldered on a protoboard.

Examination: For a teacher/assistant, demonstrate on an oscilloscope that you can generate the signal.

Lab 5: Digital filter design

Dates: Sep 20, 21

Task: Using online material and basic programming, do some exercises in digital filter design and implement them.

Examination: Fill in the lab report and upload to Canvas.

Lab 6: Implementation of a complete measurement system

Dates: Sep 28

Task: Extend the solution of lab 1 to also send the filtered signal values to a web application. The web application should show the curve data as well as the calculated heart rate.

Examination: Demonstrate for a teacher at Oct 7.

Lab 7: Basic measurements

Dates: no dates
Task: Evaluate the measurement accuracy of your lab 1 solution.
Examination: Write a report with measurement accuracy results and hand-in in Canvas.

Projects
In period 2, two projects will take place in groups of about 4 students.

Flavour-based Project. The first project is around 3 credits in size and will be defined based on one of the flavours (biomechanics, imaging, health systems). The project goal will be given later, but will be of a practical nature, where the student groups are asked to make a real prototype solution for a problem. The solution needs to be evaluated as well, such as its measurement accuracy if relevant, etc.

Project start: November 1 (Lecture on Nov 3)
Seminar 1: November 9, 11,12
Seminar 2: November 16, 18
Presentation: November 22-24 (compulsory attendance for everyone)
Deadline report: November 29

Support time: November 15

Both the groups and the topics will be decided by the course responsible. Students choosing the same flavor will randomly be assigned a group. All groups with the same flavor will do the same project. Each project will have an external "customer", which you can interact with for more clarity of the project goal.

The projects should be organized with agile/scrum project methods. Recommendation is to use Trello with Agile templates and structure the project in 3 sprints. The teachers need to be able access this information.

The project is presented as a live demo (recorded video if live demo is not possible) and a printed poster. The poster must be submitted two days before the presentation day because of printing.

The seminars are used to present the current state of each project. And to discuss problems that you are facing. Informal oral presentations of the current status are expected from all groups at both seminars.

The project must also deliver a written report that describes the project's aim, design, and results. In addition, relevant ethical and sustainability aspects must be included. There must be one section highlighting each student's contribution to the report and project. There is no page limit on the report, but it needs to contain the relevant parts and should avoid unnecessary repetition.

Track-based Project. The second project is around 4 credits in size and will be defined based on one of the tracks (computer science, electronics, physics). The project goal will be given later, but will be of a theoretical nature, where the student groups are asked to write a state-of-the-art report on a given subject area.

Project start: November 26
Report deadline 1: December 17
Peer-review deadline: January 4
Presentation: January 8
Report deadline 2: January 13

Support time: December 6

In this project, you are allowed to form your own groups as long as everyone in the group have selected the same track. Depending on the selected track, you will be assigned a topic to write about. All groups belonging to the same track will be assigned the same topic. For each topic, there will be an external "researcher" associated that you can interact with for more clarity of the topic and research questions.

It is up to the group how to plan the activities in this project.

The project must deliver a written report that presents a literature study according to the topic. A small proof-of-concept implementation of one of the identified solutions in the subject area must be made and the results included in the report. In addition, relevant ethical and sustainability aspects must be included. The report should be written in the same style as a final thesis report. Hence, it is advised to use such a template and follow the same structure, unless you have good reasons not to.

The report must not be longer than 4000 words, excluding references. Note that usually a long report is not better. A report should only contain relevant parts, avoid unnecessary repetition, and describe everything in a compact and concise fashion. Be sure to present a research question and everything in the report should address that question. Hence, no need to explain a lot of half-relevant stuff.

A tentative report that is 75% finished should be submitted by the report deadline 1. This version is distributed to other students in the course for written peer-review. Providing peer-review feedback is an individual task. Everyone will peer-review one other report.

Individual assignment. At the end of both projects, each student must submit a written self-reflection analysis that discusses the following points:

- Was everyone equally involved in the projects?
- What could you have done to make your groups work even better? Decide on two items that you could have done to improve the group's functioning and outcome. Describe and motivate your two items.
- What knowledge gap did you have before the projects? How did you fill them as part of the project?

Deadline individual self-reflection: January 16

Examination and final grade

To pass the course you have to comply with:

- PRO1 (grade A-F)
    - All labs (1-7)
    - The practical flavour-based project (one of biomechanics, imaging, health systems)
    - The theoretical track-based project (one of computer science, electronics, physics)

- The individual self-reflection report

Grade criteria

Final grade is the same as the grade of PRO1.

To obtain grade E on PRO1, the student must have completed all required parts of the course to satisfaction.

The two projects will be graded (A-F) and the grade for PRO1 will be the higher grade of the two, given that all required parts of the course have been completed to satisfaction.

To obtain grade E on a project, the student must also be able to:

- fulfill all intended learning outcomes for the project.

To obtain grade C on a project, the student must also be able to:

- show skills in project planning, by submitting required material on time.
- create, analyse and critically evaluate **several** technical solutions to a given problem

To obtain grade A on a project, the student must also be able to:

- create, analyse and critically evaluate **many relevant** technical solutions to a given problem
- produce a report that is well-written, very clearly communicates the main results.
- within the frame of the specific project, identify **several** relevant aspects of sustainable development
- within the frame of the assigned project, assess and show awareness of **several** ethical aspects on research and development work with respect to methods and results of the project.

Students that fulfill the criteria for grade E and nearly fulfill the criteria for grade C, may be awarded grade D. Students that fulfill the criteria for grade C and nearly fulfill the criteria for grade A, may be awarded grade B.

Further notes

All hand-ins are scanned for plagiarism. All external sources must be referenced and properly indicated as someone else's work. However, we encourage the use of others' work when possible and applicable. You may include figures and graphs from other sources as long as this is clearly indicated in the reports with proper referencing.

In accordance with *Handbok 444 Elinstallationsreglerna - SS 436 40 00*, it is not allowed to work with voltages above 25 VAC or 60 VDC. For instance, you cannot work with 230 V connections, unless properly encapsulated by the manufacturer.