COURSE DESIGN

Briefly describe the course design (learning activities, examinations) and any changes that have been implemented since the last course offering.

The course starts with an introductory lab assignment “PingPong” that introduces the students step by step to the Integrated Development Environment (IDE) that is used in the course, as well as to Test Driven Development and code documentation.

The course includes two seminars that focus on hardware development for embedded systems and software development for embedded systems respectively. Both seminars are connected to the project task and prepare the students for this.

The project focuses on the development of an embedded system where hardware is provided by the teacher and students develop the software. The project is then basis for PRO1 that also determines the grade of the student on a scale A to F.
The grade for PRO1 is determined based on:

- Panning, architecture, structure, testing and documentation
- Complexity of the project (several features are requested from the students and can be selected by the students. The composition of realized features determines the points for this part)
- Written report
- Utilizing a Real-Time Operating System for the project

The theoretical part of the course is originally structured in 7 lectures (see below for changes in this year’s instance). The lectures cover all aspects of the embedded systems development, but focus most on hardware, software and real-time aspects.
The written exam has a Pass/Fail grade which is also required to pass the course.

Also, this instance a flipped Classroom approach was implemented. The course material was logically divided into 6 thematic modules that were then supported by multiple pre-recorded lectures (each) as well as written material.

The first lecture was given online live and has additionally been recorded.
For every lecture that was originally scheduled a Q&A session was offered remotely which was also linked to the thematic modules prepared for self-study. For specific questions students sent before the Q&A session slides have been prepared to aid the explanation during the session.
A live lecture was given via Zoom to introduce the project task.
To provide structure to the self-study a suggested work schedule was prepared for each of the course weeks that provided suggested timeframes to indicate intended work with each of the course elements (provided in textual from as well as weekly Gant chart).

Students expressed the wish to be able to participate in labs remotely as well as in-person.
Therefore, the lab was scheduled on-site with the possibility to attend via Zoom (this was possible as a lab assistant has been assigned to the course).
The practical activities can be grouped as follows:

- One initial lab to help students install the required software and answer questions.
- Demonstration of lab tasks and intermediate project results
- Lab sessions that were intended to answer questions

The project task has been redesigned as well. Instead of 3 sub-tasks that all need to be completed to achieve full points for project complexity, 5 tasks were available out of which the students could pick up to 3 tasks.

This instance, 20% more students registered for the course as in previous years.
40 out of the 64 students registered in LADOK wrote the exam on January 13th.
32 of the students that wrote the exam achieved a passing grade and 8 students did not.
7 students were active in the course and passed PRO1 but did not participate in the exam.
4 registered students did not actively participate in any of the course elements.

THE STUDENTS' WORKLOAD

Does the students' workload correspond to the expected level (40 hours/1.5 credits)? If these is a significant deviation from the expected, what can be the reason?

The course analysis showed that one student spent 30-32 hours/week on the course. The majority of the students who answered the course analysis required around 20 hours/week which is as planned. Students who provided written feedback highlighted that challenges that lead to longer time spent on the course might be attributed to insufficient pre-requisites.
In total 18 students answered the course analysis (28%)

THE STUDENTS' RESULTS

How well have the students succeeded on the course? If there are significant differences compared to previous course offerings, what can be the reason?

The course results are good and in line with the results and grade distribution of previous years.
All students who actively worked with the project have passed PRO1. The exam focuses on the theoretical aspects of the course was passed by most students who worked with the course material (80% of the students who wrote the exam passed the exam).

OVERALL IMPRESSION

Summarize the teachers' overall impressions of the course offering in relation to students' results and their evaluation of the course, as well as in relation to the changes implemented since last course offering.

The polar diagram shows a positive impression by the students.
Most evaluated points achieved a good evaluation (between 5,6 and 6,4).
3 evaluated points were judged less positive at 4.7, 5.2 and 4.6 respectively (Nr. 5, 17 and 20).
Nr. 5 evaluates the feeling of togetherness with other students. While laboratory exercises were on-campus, several students decided to join remotely due to the Covid-19 pandemic.
Nr. 17 evaluates if students background is sufficient for the course. The students who take this course come from several different programs and schools at KTH. Because of this, there has traditionally been a wider spread in the students' background knowledge.
Nr 20 evaluated the opportunity to influence course activities. The spread in answers is very broad. Unfortunately, the only written feedback is positive and can't be used as guide to explain the result. Feedback was incorporated into the course instance and on several occasions, polls were used during the Q&A sessions to get and implement students feedback on certain aspects of the course (however, only a smaller number of students attended those sessions).

ANALYSIS

Is it possible to identify stronger and weaker areas in the learning environment based on the information you have gathered during the evaluation and analysis process? What can the reason for these be? Are there significant difference in experience between: - students identifying as female and male? - international and national students? - students with or without disabilities?

The learning environment is seen positive. The flipped classroom approach works well and is appreciated by the students. Based on the written feedback by students the students appreciate the practical nature of the course as well as the provided lectures.
The feedback from students with disabilities was slightly poorer. Written feedback indicates challenges with reading industrial documentation and datasheets, which is central to the practical parts of the course (the course will be improved in this perspective, see below).

PRIORITIZED COURSE DEVELOPMENT

What aspects of the course should be developed primaily? How can these aspects be developed in short and long term?

For the next course instance P2 HT22 the following changes will be implemented:

- A new project is currently under development and will be implemented in the next instance.
- The laboratory exercises will be redesigned as well to incorporate students' feedback:
    - Guide on how to read a datasheet
    - Introduction exercise can be connected to the project to ease the initial complexity
    - Real-time lab will be redesigned.
- On a more long-term scale automated grading of laboratory and project tasks is investigated. This will reduce the workload on teaching staff. More time to discuss with students in the lab will be a result. The automated grading framework will also be linked to continuous integration and testing of embedded systems which is part of the course content.