

# Course Analysis: 2B1445 Embedded Systems (Period 1, 2004/2005)

## Course Data

Lectures	22h
Seminars	12h
Laboratory	20h (6 labgroups)
Course responsible	Ingo Sander (22h lectures, 7h seminar)
Assistants	Mladen Nikitovic (3h seminars, main lab assistant for 3 labgroups) Rene Krenz (2h seminars, main lab assistant for 3 labgroups)
Credits	5p (TEN1 3p; LAB1 2p)

## Quantitative Data

Number of registered students: 104 (TSOCM: 71, TTITM: 12, FRIST: 11, IT: 6, TINTM: 2, E: 1, ME: 1, TWSSM: 1)

Degree of performance (2004-11-12):

- Students that passed first exam: 75 (72.1%)

Grade	Students	Percent
5	18	18,0%
4	25	25,0%
3	32	32,0%
U	25	25,0%
Total	100	100,0%

- Students that completed laboratory: 94 (90.3%)
- Students that passed all course requirements: 74 (71.1%)

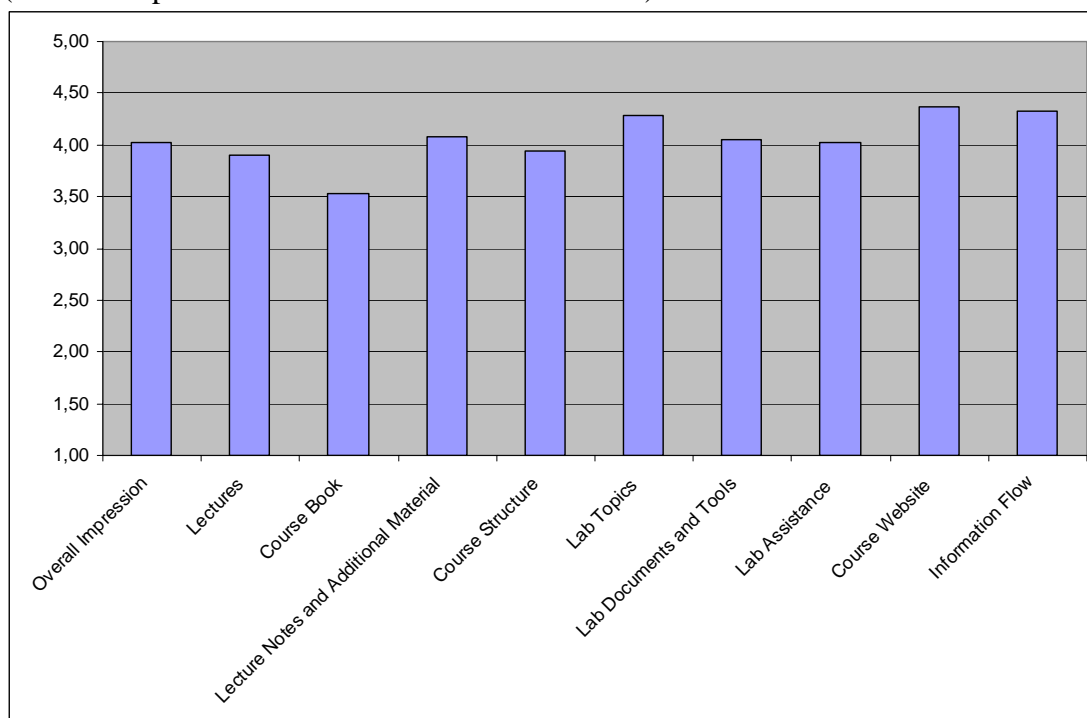
## Current Course: What was new?

I took over the course after Mats Brorsson. Since it was my first “embedded systems” course I did not change the course structure or laboratories. I based the lectures on the book on Wayne Wolf, but tried to insert many own slides, to improve the presentation of the material. Before each laboratory there was a seminar. In the first hour of the seminar one assistant gave an introduction to the laboratory. In the second hour I calculated some exercises. The last seminar did only contain exercises.

The course was taught in English.

## Evaluation and Comments on this Year's Course

The course evaluation shows that the students have been satisfied with the course (Overall Impression = 4.02 on a scale from 1 to 5<sup>1</sup>).



	<b>5</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>Total</b>	<b>Average</b>
<b>Overall Impression</b>	21	48	15	2		86	<b>4,02</b>
<b>Lectures</b>	21	44	15	6	1	87	<b>3,90</b>
<b>Course Book</b>	12	35	24	12	1	84	<b>3,54</b>
<b>Lecture Notes and Additional Material</b>	29	40	12	5		86	<b>4,08</b>
<b>Course Structure</b>	21	41	22	2		86	<b>3,94</b>
<b>Lab Topics</b>	37	36	10		1	84	<b>4,29</b>
<b>Lab Documents and Tools</b>	28	37	16	4		85	<b>4,05</b>
<b>Lab Assistance</b>	26	37	16	4		83	<b>4,02</b>
<b>Course Website</b>	46	27	8	2	1	84	<b>4,37</b>
<b>Information Flow</b>	36	37	7	1		81	<b>4,33</b>

Here follow some comments from the students without particular order, which have been given in the course evaluation (87 students):

- Lab assistants have been very good, but more are needed
- More books should be suggested
- Labs should also have parts, which are implemented in Hardware
- More real-world applications
- Very important course
- It should be stated in requirements that you need assembly language
- Seminars should give better introduction to labs
- More exercises should be solved in class in order to be better prepared for exams

<sup>1</sup> 5 = very good, 4 = good, 3 = average, 2 = bad, 1 = very bad

- We should use a “real ARM processor”
- Very good that labs follow course structure
- This is the most excellent course I have ever taken
- Good lectures contents with good slides
- Well planned structure
- A better lab tutorial to software needed
- Sometimes discussion of lecture slides was too fast
- Course book is too broad and does not go deep into the subject
- Fast update of the webpage
- Sometimes too many slides, which makes it difficult to identify the most important parts
- Keep up the good work!
- Good notes, good web publishing
- Course should be taught in two periods
- Good division between labs and lecture times
- More examples and exercises on the whiteboard
- Lecturer sometimes speaks too fast when explaining something complicated
- The book has a lot of mistakes and explains in a strange form
- The notes are clear and easy to understand, but they refer too much to the book
- More references to the ARM processor needed
- Would like to have lab assistance outside the lab times
- I like better when you explain than the explanation in the book
- The lectures were clear, well organized and easy to understand
- Good variety of lab topics
- Lab Assistants were great: helpful, friendly, well prepared and well informed
- Course covers a lot of chapters in a limited amount of time
- Sometimes lectures were boring
- Lab documents were good but simulator creates problems
- More emphasis on operating systems, code reusability, compiler

## Course Committee

The result of the course evaluation was further discussed in the course committee (Date: November 9, 2004, 13.15-14.15).

Participants: Ingo Sander (Course Responsible), Guang Liang (Student TSOCM), Emilia Andersson (Student TTITM), Chirag Dadlani (Exchange Student), Maksym Bryzgalov (Student TSOCM), Mladen Nikitovic (Course Assistant).

The course committee agreed on the following:

- *Course Structure and Contents:* The course is well organized, but there were many topics, which could only be touched superficially. Instead there should be more focus on fewer topics, which can then be discussed in depth. As an example, the part on compiler strategies can be moved to another course (2B1463 Embedded Software), and the time could be used for a more intensive discussion of embedded system platforms (buses, memories, DMAs). The students appreciated the mailing list for the course, but it could be used more often.
- *Lectures:* Lectures have in principle been good. However sometimes there have been a little bit too many slides. Most students appreciated the

discussions of exercises on the whiteboard, which could be extended. A student proposed to reserve some time in the lecture (about 15 minutes) for discussions with the teacher, which is a little bit difficult with 100 students in a class. Instead I have tried to use breaks and the time after the lecture for discussions. However, this seems not to be enough and since there are so many students dedicated office hours should be introduced in next year's course.

- *Course Material:* The students have not been very satisfied with the book. Many topics have been discussed only superficial and also explanations have not been clear enough. Also the book contains many errors. Lecture slides gave good information. Links to other information sources could be put on the web page.
- *Laboratories:* The students agreed upon that the lab topics were well-chosen. However, the labs could be more challenging. Since all labs have been run on a simulator, it was proposed that at least some labs should be implemented on real hardware. The students experienced that there have been not enough lab assistants in the first three labs, i.e. only one assistant for 20 students. In the last two labs this number has been increased to 1.5, which means that there have been one lab assistant in the first two hours and two lab assistants in the last two hours. This solution worked much better. Another problem was that there have been students who have not prepared properly for the lab. Here the course team should be more strict and only allow students that have prepared to come to the lab. Another idea was to have a small project in the lab course. However, the course leader had bad experiences in earlier years with these kinds of projects, since it requires a large amount of administration and many student groups underestimate the problems and take too large projects.
- *Examination:* It was suggested by the students in the course committee that the examination should contain more challenging tasks. The course leader agreed.

## **Proposed Changes for Next Year**

The course will get a new course number 2B1446 and will be a C-level course. One difference will be that the prerequisite requirements are increased by requiring the course 2G1518 Computer Hardware Engineering, 5 credits. This allows moving to a more advanced level, since the student should know concepts as pipelining and caches. Thus more time can be spent onto specific embedded system problems like an introduction to real-time software and programming for power-efficiency.

The laboratory part will also be significantly changed, since it is planned to use FPGAs with an embedded microprocessor core as target architecture. Then most of the labs will require an implementation in hardware, which means that the students get a better understanding on the problems arising when dealing with real hardware.

Also a new course is introduced in the next year. The elective course 2B1463 Embedded Software will allow for a detailed discussion of problems in embedded software design, while the new embedded system course shall give a thorough overview about embedded system platforms, but does only give an introduction to embedded software design.