Course Analysis

Course data

Course name	**ENERGY AND FUSION RESEARCH**
Course number	ED2200
Course credits (total) and credits for each module	6 hp Hand in assignments (4.5 hp) + mini group works (1.5 hp)
Time for course offering	Period 4, 2023
Course responsible and other teachers	Per Brunsell EECS/Electromagnetic Engineering and Fusion Science
Teaching hours, distributed on F, Ö, R, L, S	24 F + 12 Ö (Notation: F – lecture, Ö – exercise session, R – ”räknestuga”, L – lab session, S – seminar)
Registered students, number	38 students; four students did not finish the course
Performance indicator, after 1 examination offering, %	
Examination rate, after 1st examination offering, %	79 % (30 students)

Course goals

Specify the overall goals for the course	The course should provide insight into how and why fusion energy will be a part of the energy future, as well as give understanding for the basic plasma and reactor physics in current and future fusion power plants.
Specify how the course is designed to meet the goals	The lectures are goal-oriented and they focus on topics relating to the course goals and content. The course requires continual work and is examined on a continual basis from home assignments and participation in mini-group work. Grading: P/F. No final exam is given.

Pedagogical development I

Describe the changes that have been made since the last course round. (Tell the students at the start of the course)	The course book and lecture slides have been updated. The initial chapter of the book has been extended, providing a more comprehensive introduction and background to the subject. This year the credit point system used in the continual examination was slightly regarding the mini group works. The aim of the change was to increase attendance at the final group work sessions,

Student contact

Students in this year's course committee; name and email	We do not employ course committees. The course design has been well developed during a number of years and assessed in surveys, so we do not consider a course committee to be needed. Important instruments for course development are * two written formative questionnaires (95 % response) * informal discussions with the students
Results of formative middle course survey	Not employed.
Results of course committee meetings	Not employed. Integrated course evaluations (weeks 2 and 6) provide helpful information, discussed in the group.

Course evaluation; student viewpoints

Period, when the course questionnaire was available	The course evaluations were open course weeks 2 and 6 and integrated in the course as part of other course assignments. Typically the students are positive to having integrated course evaluations.
Questions in the questionnaire	New questions were introduced in 2019. (The previous questionnaire was used essentially unchanged since the start of the course.) There are both multiple choice questions (4 grades: ++, +, -, --) and free text questions. **Questions 2023:** Most questions are the same in survey 1 and survey 2. This gives a good picture of the course's progress. Green-marked: 1st course survey only Brown-marked: 2nd course survey only ***Compulsory*** • Is there a good match between your pre-knowledge and the course content? • Does the course content match your expectations? • Do the intended learning outcomes help you understand what you should learn in the course? • Is the course literature adequate? • Are the most central topics for fusion energy given sufficiently hig priority, you think? • What do you find most important in this part of the course? (5 options given) • Looking at the first two weeks of the course, what would you primarily like to learn more about? (5 options given) • What, in your view, is the major reason that we do not have commercial fusion energy today? (5 options given) • Looking back at the course, what would you like to have learned more about? (In the last course week we will study alternative fusion schemes, design of a fusion power station, safety and environment as well as costs for fusion). (5 options given) • Is the course design well adjusted for your learning in fusion physics? • Do you prefer lectures with blackboard based presentations (as compared to ppt slides)? • Is it clear what you are supposed to learn, and to what level, for passing the course? ***Optional*** • Are lectures and learning activities planned for a good pace in the course? • Do you like the mix of learning activities (lectures, home assignments, exercise classes, mini group works)? • Is there an including, friendly atmosphere in this course? • Do you receive sufficient feedback to see your progress? • Is the assessment well designed and fair? • Is it a good idea to integrate this survey into the course? • Is there anything you would like to change in the course? • Any additional comment, on the first 10 questions above for example? • I am a woman/man/other
Response frequency	1:st survey: 95 %, 2:nd survey: 76%

Changes since previous course round	-
Overall impression	The integrated course survey is well received by the students.
Positive viewpoints	- It was good to start the course with a general overview of the glob energy production and its impact. - I am from renewable energy course with mechanical background and I don't have advanced physics knowledge. But I learned quite a lot about nuclear and plasma physics from the course. - I think we have had a good ambiance and dialogue in the classroom where questions are welcome. - I think the tutorials have been at a good level - well done with hov the relevant theory is presented again - I think the course as a whole has been good. It gives a good broad overview of fusion physics - Normally I am pro-blackboard based lectures, but I think it is good to include ppt in courses like this that have a lot of visual elements (how a Tokamak looks like etc.) - I have not experienced anything in this course that I believes need to change. - Thank you very much for this course! I didn't know what to expect but was happily surprised and enjoyed it very much. *About integrated course survey:* - I think it is always a good idea to look at feedback and integrate it accordingly if a sufficient amount of critique is brought up - Gathering feedback in order to try and make the course better and better is always positive. Doing it on the second week is also a positive point, as it makes it possible to act on the feedback in the present, as opposed to only doing a final survey, where the feedback will only apply to the future, for the next year's class. Hence, it makes the feedback more valuable. - It is good to integrated because otherwise the evaluation is most likely not done by the majority of the students attending the course . - This survey gives the students a possibility to give their opinions on the course and give suggestions on how to improve it.

Negative viewpoints	- Perhaps also add a little bit more general overview of the status of fusion research: What do we believe are viable paths? What has failed? Is it more funding or more time that is actually needed to build a commercial fusion power plant? - Maybe give the lecture a bit more structure, for example when we talked about plasma models. - I've thought it a bit unclear what the level of the mini group work will be. Maybe the exercises give a good picture of the area /level? - I think it's a bit too much focus on solving mathematical problems. I would like to stay on a more theoretical level. - I think more thought and discussion should be added around how we are to handle the increasingly lacking tritium supplies available. - I would like to suggest more classes on the basics as it would help students like me who are not from physics background to follow the course the better. - I think we have focused a bit much on the maths, since as I understand it from the learning outcomes - the maths are not the central figure in the course - I understand that the course is offered to students with different backgrounds, but maybe a bit more derivations to the physics behind the relations we have would be nice. - I think the assignments are maybe a bit too easy, meaning that a full understanding of the class is not needed to pass the class. I think it would be great to have exercises to study a bit more in depth. - I think it would have been easier to understand the material if the course would have started with a more detailed overview of reactor design and the issues that need to be solved, e.g. heating, stability, strong enough magnetic field, impurities, etc. - I think a greater focus on fusion and it's integration commercially in the energy system and the practical issues presented (EU, Sweden, etc...) would have been nice. I felt that the course was very heavy mathematically with the topic of nuclear physics instead of nuclear energy. - I think the course is good but it requires a good background in physics
	In the summary below the multiple choice questions answers (++) and (+) are regarded as supporting the statement in the question.
Was the course relevant wrt the learning outcomes?	97% of the students responded that the learning outcomes helped them to understand what they should learn in the course.
Views on preknowledge	86 % of the students answered that there was a good match between their pre-knowledge and course content. This response is satisfactory. A higher value may not be expected since students come from various study programmes.

Views on course design	97% of the students replied that the course design is well adjusted for learning in fusion physics.
Views on course material	All students responding to the survey had a positive view of the course literature.
Views on examination	83% of the students answered that the assessment was well designed and fair.
Particularly interesting comment	• Many students thought that it was a good idea to integrate the survey into the course. One student answered: “It is good to integrate because otherwise the evaluation is most likely not done by the majority of the students attending the course” • All students that responded to the question supported the statement that there is an including, friendly atmosphere in the course
Relevant web-links	

Course evaluation; teacher interpretation

Comments	All students answer multiple choice questions in the integrated course surveys. In addition, many students provide detailed and constructive comments that will help improve the course.

Comments from other teachers

What worked well	-
What did not work well	
Suggestions for changes	

Course committee meetings; summary

Student summary	-
Suggestions for changes	-
Link to meeting minutes	-

Final course meeting

Summary	-

Course responsible, summarising comments

Overall impression	The course round 2023 had a record number of registered students (38). Presumably, this increased interest for the course reflects the recent positive reports in media about fusion.
Positive viewpoints	The course is perceived as a good, broad overview of fusion physics. The students feel that there is a good ambiance and dialogue in the classroom where questions are welcome.
Negative viewpoints	Many students think there is a bit too much math, and that the course should focus more on the status of fusion research, the reactor design and the issues that need to be solved.
Views on pre-knowledge	Some students may not have the background that is needed to follow certain details of the course material. Learning these details is however not required for the main learning outcomes or for the student to pass the course.

Views on course design	The survey results indicated that the students appreciate the course design with its mix of lectures, home assignments, exercise sessions and mini group works.
Views on course material	The course book has been updated for this course round, and it is satisfying to see that all students responding to the survey had a positive view of the course literature.
Views on examination	A large majority of the students answered that the assessment was well designed and fair.

Pedagogical development II

How the changes for this course round worked out	The updated course material has been received well by the students according to the survey. The modified credit points system for mini group works had a positive effect on student attendance in the final cour week.
Changes to be made for next course round	Further updates of the course material is planned. The aim is to include more overview material relating to current fusion research and the issues faced in the reactor design.

Other

Comments