COURSE ANALYSIS

An asterix (*) denotes non-compulsory data.

Course data

Course name	**Design of Electrical Machines**
Course ID	EJ2222
Credits	7.5
Time period for course	**Study period 1, autumn 2015**
Teachers	Oskar Wallmark
Classroom hours	32 hours (major part of work carried out outside the classroom hours)
Nr of registered students	8 (=number of students following the course)
Examination rate, in %	TBD (deadline for hand-in assignments has not yet passed)

Goals

Global course goals	After completion of the course the student shall be able to: • Apply the theory of MMF-waves to estimate air-gap flux densities, magnetic flux, inductances, and to derive the steady-state equivalent circuit of the induction machine (IM) • Apply the theory of MMF-waves to analy ze and understand limits of permanent-magnet synchronous machines (PMSMs) • Implement a finite-element (FEM) based solver in a Matlab environment to solve static and quasi static, two-dimensional magnetic problems • Use FEM-based computations to estimate different performance parameters of IMs and PMSMs • Estimate stator and rotor resistances, magnetizing inductances and leakage-inductance components for IMs and corresponding parameters for PMSMs using analytical and numerical methods • Carry out a preliminary electromagnetic sizing of an IM given a defined torque request and thermal limitations • Carry out FEM-based computations on PMSMs to extract data to implement transient PMSM models including magnetic saturation, magnetic cross saturation and the impact of harmonics • Carry out FEM-based computations to estimate the resulting temperature distribution in an electric machine of IM or PMSM type
How the course design helps fulfill these goals	The concepts are presented during the lectures and are worked with by the students in the project work.

Pedagogical development - I

Changes made since previous time course was given	A course compendium previously used in EJ2210 was revised substantially and extended with two new chapters on permanen-magnet motors and thermal modeling.

Course evaluation; comments from students

Based on the questionnaire used at the Division.
If the course has less than 10 students, the questionnaire can be replaced by informal discussions.

Evaluation response rate*	7/8 students.

Overall student view*	• 4 students (60% of the respondents) gave the course an overall grade of 4/5. The remaining 3 students gave the course an overall grade of 5/5
	• Final comments regarding the course:
	  ○ Very good and interesting course!
	  ○ Very good course I hope it will stay for a long ime so that other students can get the knowledge that was given. However it is very time consuming.
	  ○ The course is very clear and well explained. Projects are interesting because the use a lot of what we saw during lectures so that we can practice and learn from our own mistakes.
	  ○ Keep up the spirit. I believe such courses will increase the popularity of studying electrical machinery in the long run. The course is a good role model for other courses of the older standard which rely on analytical formulas and writing an exam without understanding the context of the formulas.

Positive comments	• What was best with the course?:
	  ○ Getting to work round the FEMM software. Projects gave us a good amount of understanding the theory.
	  ○ The strong pedagogic influnce in the book and the projects. To brake down the field into Maxwells equation understanding and learn how to use FEMM.
	  ○ the possibility to ask quatrains or argue about a part of some theroi or just problems or results in the projects
	  ○ I really enjoyed the simulation part, wit FEMM and Matlab because what we saw during classes becomes more concrete
	  ○ The assistance of Oskar Wallmark was very good and i got a deep understanding of electrical machines.
	  ○ The project slots, with the opportunity to discuss with teacher and other students.
	  ○ A nice course compendium. I think I learnt a lot in the project about synchronous PM machines.

Negative comments	• What was worst with the course?: ○ I felt it would have been good to jointly discuss the results in the project after they had been handed in. Then any question marks could be straightened out and solution methods be discussed. I would also have appreciated if you could have given some pieces of advice during the computer labs on common problems that were encountered by many students.

	○ Maybe some sentences in the Project could be a little more detailed (like in Project 3, how to take harmonics into consideration). ○ The workload of project 5. ○ That there were no lecture in how to use FEMM in practise. An early tutorial going through key understandings in the sotware would have spared a lot of time for project 1. Which was the most time consuming project of them all. Moreover, some of the projects would need to have better explainations on what the students are supposed to do. For example using multimeter in project 1. ○ Time between the deadlines are not sufficient. ○ Long intervals between the seminars. And the assistance of the PHD Student was not a good alternative to the assistance of Oskar Wallmark.
Pre-knowledge, comments*	• Additional comments regarding background knowledge: ○ Could have had more experience within the field of electromagnetic feild theory. But who doesn't?
Course design, comments*	
Literature, comments	• Additional comments regarding the course book ○ Very illustrative and straight forward ○ I did not read about fem, since I did not intend to do project 5 ○ Great content and very pedagogic. For some topics the book was not enough to understand some topics for the projects. Then teaching assistance was needed.
Examination, comments	• Additional comments regarding the examination ○ Every project refers to a chapter in the book so we can practice almost everything we learnt during classes. ○ I think the structure is great. 4 mandatory projects and a fifth that you can do if you have time. ○ I feel that the time between deadlines for submitting the project are short. It would be nice if the time between two deadlines is increased ○ The current project form of examination is preferred and considered very pedagogic
Particularly interesting* comments	• Some interesting comments are highlighted above.

Course teacher's impressions from the evaluation

Comments	I am happy with the constructive feedback I have received.

Course teacher's summary

Overall view	• I am relatively happy with the course outcome

Positive comments	• See above
Negative comments	• See above
View on pre-knowledge*	• See above
View on course design*	• This course design enables participants both from PhD students from other universities (following the course EJ3222) and nearby industry which both are very important types of participants for the EES school.
View on course material	
View on examination	• This type of examination works generally well with PhD and late year students.

Pedagogical development - II

Outcome of course changes made since last time course was given	-
Changes to be made before next time course is given	•Fixing smaller errors in the existing projects and adding an additional project on hysteresis modelling.

Other

Comments*