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 2017**
Teachers	Oskar Wallmark
Classroom hours	32 hours (major part of work carried out outside the classroom hours)
Nr of registered students	19 (=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	The course compendium used last year was revised somewhat and an additional project on transiemt modeling of permanent-magnet drives was added.

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*	14/19 students.

Overall student view*	• 1 studen (5% of the respondents) gave the course an overall grade of 3/5, 5 students (35% of the respondents) gave the course an overall grade of 4/5. The remaining 8 students gave the course an overall grade of 5/5
	• Final comments regarding the course:
	  ○ Thank you. This was truly a great class and I am thankful that I was able to particiate in it.
	  ○ Happy to have taken it and glad to have been taught by Pr. Wallmark. Hoping to have the chance to work with him again in the future.
	  ○ Very nice course!
	  ○ Having in mind that it was a 5 week 40 hours course I belive that Oskar did his best to cover most of the material and I really appreciate it. However in order to deeper understand some concepts more time is required (maybe a thesis in the field)
	  ○ Best course to be taken in KTH

Positive comments	• What was best with the course?:
	  ○ We can see a real machine and his model on matlab
	  ○ The clarity and thouroug explanations of forumulae
	  ○ Oskar was the best. For realt thouhg, I truly enjoyed all of the projects, and lectures.
	  ○ Working on one's own to solve the problem was a good experience.
	  ○ The professor is highly competen and knowledgable and masters his domain. The exercices are challening and difficult and very instructive.
	  ○ The assignments are very well structured. For 5th assignment would be helpful to have more guidance
	  ○ Projects
	  ○ I understood how the same machine concepts are approached from different perspectives
	  ○ Course was well organised with good assignments

Negative comments	• What was worst with the course?:
	  ○ The presentation of the lectures could stand to be a bitt less dry and more semantic in his approach
	  ○ That the projects were a little bit uneven in workload
	  ○ I don't think I disliked something
	  ○ Teaching could be bit more explanatory

Pre-knowledge, comments*	• Additional comments regarding background knowledge:

	○ The first lecture was very helpful in remembering what I needed to know ○ I had the feeling that the background knowledge was very different in this course. ○ Introduces a lot of heavy electrophysics and thermal engineering and then doesn't really give students the time or experience to really become familiar with these notions with any depth. ○ The introductory electromagnetics lecture was good – include this lecture next year ○ I had taken the course Electric Machines & drives and Power Electronics
Course design, comments*	
Literature, comments	• Additional comments regarding the course book ○ It's a really interesting book and complete. I will probably keep it for myself in case I work with electrical machine in the futur. ○ This was very well written. I really enjoyed it. ○ This book is a good fast summary of the important steps for designing electrical machines. As an introduction it is helpful. ○ It's perfect for solving the exercises, but not for understanding the concepts in depts. I It could stand to have more exercises with solutions, or cbe complemented with an exercise compendium. The equations with high interdependence could stand to be structure into a chart that shows how they connect with each other and helps the stduent gain a semantic understanding of the course. ○ Very good context. Maybe at some points in the book it can be clarified in a more analytical way how a formula is derived (I am having in mind no more than 5 formulas that are lacking further explanations) ○ Course book is good
Examination, comments	• Additional comments regarding the examination ○ Project one is very complicate compare to the others ○ I thought that the first two projects helped very much in understanding the material. I do think that the second two were to easy, and a little much was fed to us. I think something which could be helpful is to have us derive similar equations for a different machine, and that would help us to truly understand the derivations better. ○ In my opinion the projects were a bit too easy to test all the knowledge needed to design a machine. ○ Everything is there, in addition to some programming skills that one has to figure out for oneself. ○ I would expect one introductory FEM project of a simple geometry (for ex a squarewise magnet, an airgap and an inductor). This way a student can understand

	in better way how Maxwell equations apply in a basic circuit. ○ Could be little more challenging and was bit easy
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. • Approximately 75% of the responding students spent around the stipulated time of on the course.
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	• Two students took the project on hysteresis modeling which was added compared to last year.
Changes to be made before next time course is given	• Fixing smaller errors in the existing projects and course literature and adding an additional project on the impact of rotor saliency in permanent-magnet motor drives.

Other

Comments*	