Course outline: PEP 397 – SKIL III

Suggested subtitle: Measurement techniques and individual project

Course Description:

Continuation and extension of SKIL II to more complex projects. Projects may include research participation in well-defined research projects. Prerequisite: PEP 298

Scope:

This course has two scopes: one to get you to get "your hands dirty" – so you will envision, build and run an experiment on your own. Yet the classes will assist you to do this in an efficient manner, including project planning and tracking skills. For this term each project has to have at least thee project members that work together towards the project goals.

Secondly the class focuses on advanced measurement methods and their correct use, as well as the understanding of the implications of those measurement methods on the data itself.

Meetings:

One lectures (Wednesday, 9PM – 9:50 PM) and one nearly 3 hour long Lab/recitation. Attendance is mandatory at all lectures and lab/recitations.

Grading:

10% class participation, 45% Homework assignments, 45% Lab assignments, which include project reports, Team presentation (poster), and Final report.

Late submission will not be accepted. Poor attendance will have a negative effect on your grade.

Learning Outcomes: After taking this course, the student will be able to:

- Use enhanced measurement techniques and knows problems or measurement errors that can arise with it.
- Do a literature search about a topic and identify the relevant publications.
- Design an experiment and develop a first plan for its realization.
- Keep an experimentation log for an ongoing research.
- Analyze measured data and interpret them in the context of an experiment.
- Present the outcomes of an experiment in written and presentation form.

SPAD-Questions:

- You understand the importance of modeling for the design of an experiment.
- You can do literature search on a specific topic and judge the quality of the article.
- You can give an interim report about the project status and outline problem, challenges and success.
- You understand how to use triggering for advanced measurements (for example at an oscilloscope).
- You know at least three different methods to reduce noise in a measurement.

Weekly topic and assignments: Lectures

Week	Lecture Topic	Lecture HW
1	Course Introdcution	Which measurement methods / instruments I know / should know / want to know
2	Meas. tool vs technique	3 examples of measurements and how to enhance them
3	Enhancing measurement	What means modulate / demodulate? What kind of noises do you know?
4	Modulation and Noise	Calculate FFTs for different signals – what are the effect of length and resolution?
5	FFT – resolution & range	What are filters and can you use a FFT as a filter?
6	Nobel Price	Was this year's Nobel price deserved?
7	Heterodyning	"Try" simulating a Spectrum analyzer in your modeling environment
8	Spectrum Analyzer	Power of dB – Why we use dB for power levels
9	Cable – how fast is it?	How will a filter (cable) effect a signal – simulate and showcase the results
10	Termination and RF power delivery	What determines the transmission properties of a cable? Calculate reflection for different situations.
11	Pulse propagation	How can a pulse propagate over a long distance? Is digital transmission better than analog?
12	Oscilloscope and triggering	Be able to identify Oscilloscope controls and their effect on supplied pictures of Oscilloscope. Analog vs digital – what are the differences / advantages?
13	Analog vs. Digital Oscilloscope	Find out what are feedback loops – and find examples where you experience / use them in real life.
14	Feedback Loops	

Weekly topics and assignments Lab:

Week	Lab Topic	Lab HW
1	What is a good project idea	Submit a project idea that you want to work
2	Present project idea / formation of groups	Submit an extended project description
3	Segments of a project	Submit initial literature review
4	Review of literature search / Scopus/ Web of Science	Judge quality of literature / continue literature search
5	Independent literature research / elements of a Gant chart	Prepare Gant Chart / start modeling
6	Simulation / Modeling as part of the project	Prepare presentation about the modeling you use
7	Presentation and feedback	Update model based on feedback / Prepare progress report
8	Review of progress	Identify experimental parameters out of model / finalize “shopping” list
9	Group work on project	
10	Group work on project / individual meetings	Prepare progress report
11	Presentation progress report	
12	Group work on project / individual meetings	
13	Group work on project / individual meetings	Prepare powerpoint / poster presentation
14	Present project powerpoint / poster	Prepare final report – What have you learned?