Welcome to Antennas workshop 2023

Your expectations (1/2)

- “learning practical applications of designing antennas and their fabrication techniques”
- “Expecting engaging into practical application of antenna design studies in ELEC-E4450 ANTENNAS course in addition to gaining enough knowledge to use CST Studio Suite.”
- “I hope to learn how to measure various kind of antennas and know the difference between simulation and practical measurement.”
- “Learn more of CST, Learn the basic workflow curve related to antenna design (idea --> simulations --> implementation --> measurements?), Learn more antenna measurements (that was done very briefly in Antennas course)”

Your expectations (2/2)

- “I hope to experience the whole process of antenna design from software simulation to fabrication.”
- “To gain practical knowledge about antenna design and measurement.”
- “I would expect to improve the skill for designing, simulating, fabricating, and evaluating the antenna arrays and low-profile backscatter antennas.”
- “I hope that in addition to designing and simulating an antenna based on some specifications we can also manufacture and characterize them during the course.”

Students' feedback from earlier years

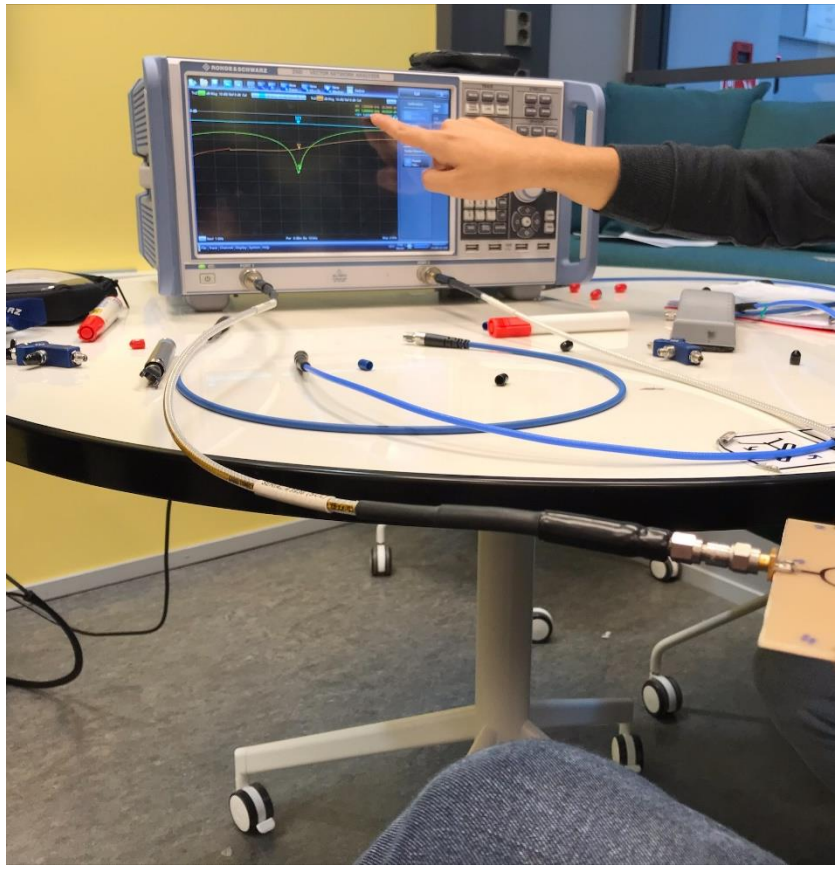
"The teaching methods supported my learning, the design projects taught me a lot more things in antenna design. Furthermore, the small homeworks, especially the one dealing with differential measurement, was really insightful and I learned a lot from it and the following discussion. Considering the dual resonant matching things, there could have been a similar small homework where students observe the phenomena by themselves. The purpose of pair work in topic 2 remained as a slight mystery for me. On the one hand, it certainly was helpful to discuss the design work with a peer and get some feedback and even design ideas to ease problem solving. On the other hand, I think that delivering a common presentation and self evaluation was a bit too much, they could have been done individually." (2022)

"Overall, this course was fun and interesting. It improved my knowledge about different antenna designs and gave me a stronger understanding of basics and even some more advanced theory. It gave me more experience on CAD modelling, which is always useful. It was a challenging course but not too challenging. It took a bit more time than I would have liked to invest in. I will definitely recommend this course for anybody that is even slightly interested in antennas and antenna design." (2021)

"This was a great course. The two different parts provided two very different challenges. The first one was an easier problem with more degrees of freedom, while the second one was much more challenging with seemingly very limited possibilities. This course has improved my knowledge of simulations and prototyping. Additionally, I was able to refresh my knowledge and learn more about different types of antenna measurements. Having to report my progress made me spend more time on processing and understanding the results. All in all, I found that this course was a nearly perfect balance between theory and practice and also individual and guided work." (2021)"

You will learn various skills in this course

- **After successful completion of the course, the student can work on an antenna project on the competent performer level**
  - i.e., the student's working is well-planned and productive, and one can recognize and propose suitable approaches in real-world situations.
- The main idea of the course is to **educate you for working life, especially on antenna and RF-related tasks, and to improve your learning-to-learn skills**.



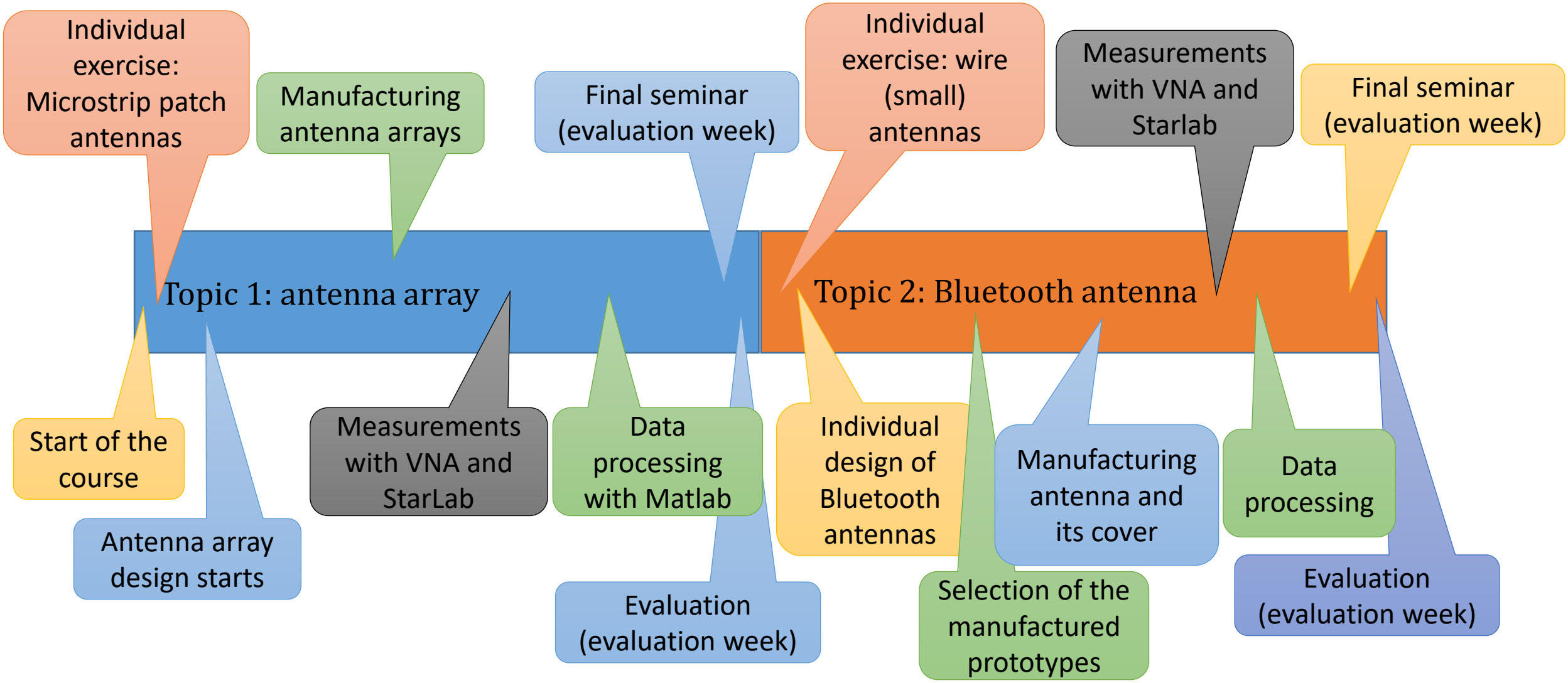
The course consists of two practical antenna design tasks in Periods 1 and 2

1. **Antenna array (Period 1)**
   - Antenna arrays is a vital research area due to their ability for directive operation and electrical beam-steering ability, e.g., in 5G and &G wireless communication systems, radars and sensors, and space technology.
2. **Bluetooth antenna for a smart watch (Period 2)**
   - This topic deals with small antennas, multi-resonant impedance matching and the effect of the nearby objects on the performance. It's a joint collaboration with Radientum.

- **In both topics,**

- Design – manufacture – measurement framework, providing hands-on experience and applying theoretical knowledge.
- Students can choose from three different levels of difficulty (basic, intermediate, challenging), impacting their grades.
- it is recommended to test new ideas, even take reasoned risks, and learn from mistakes.
- Teachers create an environment that facilitates learning and act as guides rather than provide direct solutions.

The course consists of two practical antenna design tasks in Periods 1 and 2 - timeline



You will learn various skills in this course

What do these working life skills mean to you?

Information searching and critical viewpoint of found information

Internal entrepreneurship

Project management

Complex problem solving

Social skills

Critical thinking

Knowing one's own strengths and weaknesses for individual development

Ability to apply theory on practical problems

Creativity

Group working and coordinating work with others

The list defines ten most important **working life skills** according to World Economy Forum and TEK (Union of Academic engineers and architects in Finland).

You will learn various skills in this course

- **Complex problem** (solving) means an assignment or problem which might be defined somewhat unclear, it is not straightforward to solve, and there might be several alternative solutions or even no (good) solutions at all.
- **Critical thinking** means that one can find thorough judgements before making decisions or opinions. Critical thinkers also realize those cases when there is too little facts on giving a reasonable opinion.
- **Creativity** is an ability to find new and somehow valuable ideas or viewpoint.
- **Project** (management) means setting up planned and interrelated tasks over a fixed period for achieving an intended goal.
- **Information searching** means using various independent sources (e.g., books, scientific articles, internet, expert interviews) in parallel for finding the facts among versatile information.
- **Ability to apply theory on practical problems** means that one can use the fundamental theories of physics and (electrical) engineering for explaining (new) phenomena in research, development and innovation tasks.
- **Internal entrepreneurship** refers to “game changer” attitude of a committed, enthusiastic, and self-directed employee (inside an organization) who has an aim for turning ideas into new practices, profitable products, or services.

The evaluation aims at giving constructive feedback

- The evaluation objects are – i.e., the grade is affected by
  - Topic 1
  - Topic 2
  - Individual learning and development
- Individual learning and development are affected by
  - Regularity of working and participation in the contact sessions
  - Usage of antenna design and evaluation tools
  - Ability to exploit instruction and show own initiatives
  - Quality of the results in the individual results slide set
  - Presentation of the results and participation in seminar working
  - Achievement of the applicable (i.e., situational flexibility) learning outcomes
- In practice, the evaluation of the individual part comes through individual outputs and activity during the contact sessions

Evaluation object	Criteria for ”fail” level (0)	Criteria for satisfactory (1) level	Criteria for ”expected” (good, 3) level	Criteria for “excellent” level (5)
1. Regularity of working and participating in sessions	Limited engagement and minimal participation; constantly fails to compete assigned tasks.	Engages and participates, mostly completes assigned tasks, with occasional lateness or multitasking during sessions.	**Engaged and participates actively, demonstrates regular working and effective communication. Strives to arrive on time and minimizes multitasking during sessions.**	Exceptional engagement and active participation, maintains full attention and focus. Actively contributes to valuable discussions and consistently demonstrates proactive approach to learning.
2. Usage of the antenna design and evaluation tools (e.g., mathematical modelling, EM and circuit simulators, measurements)	Fails to demonstrate of how to apply the antenna design and evaluation tools.	Demonstrates basic utilization, with limited interpretation of results and strong dependency on others.	**Demonstrates proficient utilization, providing meaningful insights and the ability to work independently.**	Demonstrates advanced utilization, providing deep insights, innovative solutions, and expert guidance for other students.
3. Ability to exploit instruction and show own initiatives	Disregards instruction and fails to show initiatives.	Follows instruction but lacks personal initiative, relying solely on teachers’ suggestions.	**Demonstrates the ability to ask relevant questions and show some personal initiatives to enhance their work.**	Actively engages in two-way dialogue, providing scientifically justified arguments and taking independent initiatives to advance their work.

Evaluation object	Criteria for ”fail” level (0)	Criteria for satisfactory (1) level	Criteria for ”expected” (good, 3) level	Criteria for “excellent” level (5)
4. Quality of the individual results, evaluated through the individual results slide set	Results are of poor quality, lack clarity and demonstrate a lack of understanding.	Basic numerical results with a lack of depth, originality, proper analysis, references, and next steps.	**The results demonstrate a clear understanding and are well-organized. They exhibit a good level of analysis, originality, references and proposed next steps.**	The results are of exceptional quality, displaying a comprehensive understanding, highly organized, thoroughly analyzed, insightful, and comprehensive next steps proposed. They show a high level of creativity and go beyond expected requirements.
5. Presentation of the results and participation in seminar working. If the student experiences stage fright, they are encouraged to reach out the teacher for support and guidance.	Does not demonstrate any merits in their final presentation.	Participates in the final presentation, but their contribution is limited in scope and lacks depth, failing to make a significant impact.	**Adequate participation in final presentations, showcasing sufficient communication skills and presenting their work with clarity and coherence.**	Goes above and beyond by voluntarily discussing their individual results during regular sessions, providing valuable input and insights to enrich the sessions. Active engagement enhances the overall learning experience of the whole group.
6. Achievement of the learning outcomes	Does not demonstrate the achievement of the intended learning outcomes.	Satisfactory level of achievement of the intended learning outcomes with clear areas requiring clear improvement.	**Solid level of achievement of the intended learning outcomes, meeting the expected standard.**	Exceptional level of the achievement of the intended learning outcomes, exceeding the expected standard with exceptional mastery.