Technical Acoustics 1, Quarter II 2022

Chalmers, Applied Acoustics

***General*:**	Number of points: 7.5. The course consists of 30 hours lectures and 6 hours exercise time.
Literature:	Course material: Technical Acoustics I, http://www.ta.chalmers.se/
Teacher:	Wolfgang Kropp
Room:	All lectures and exercises take place in the lecture room at the Division of Applied Acoustics
Exam:	The final grade is determined from an oral exam concerning the complete contents of the lectures and exercises (max 60 points) and three assignments (max 60 points), to be handed in during the course. The results of the oral exam and assignments are equally weighted. To pass the exam you have to pass the oral exam and earn in total at least 60 points. The scale for the final mark is as follows: $P \geq 100$ mark 5 $100 > P \geq 80$ mark 4 $80 > P \geq 60$ mark 3 where P is number of points gained in total. The oral exam can be taken in groups up to 3 students at any time after the end of quarter 2. Please contact the teacher for booking a time.

Assignments:

The three hand-in assignments consist of tasks that include theory, hand and computer calculations and interpretations of the results. They are graded on a 20 points scale and hence you can collect maximum 60 points from the assignments in total. The assignments are prepared and discussed on the scheduled exercise occasions.

Assignment 1: chapter 1-4
Assignment 2: chapter 5-8
Assignment 3: chapter 9-12

You get 2 weeks for working on each assignment. Make groups of two students and hand in one report per assignment and group. Hand in the assignments at Canvas course page.

It is important that you write your own calculation script, produce your own figures and formulate the report **in your own words**. Cooperation between groups is however encouraged to increase the understanding of the course contents.

- Always explain how you got your results. The intermediate steps are as important as the final result. It is not enough to only present the final result.
- Interpret your results. What do they mean from a physical point of view? Are the results reasonable?
- When you introduce variables that have a direction (force, displacement, etc.) make a drawing to indicate the positive direction.

Aim

The course intends to give an in-depth knowledge about structure- borne sound and its control. The course focuses on the prediction and control of sound propagation in structures and the radiation of sound from structures. The course is recommended for those students who intend to focus on noise control engineering. It is highly advised that students continue with Technical acoustics 2, where the subjects of Technical acoustics 1 are practiced on a real-life example.

Learning outcomes *(after completion of the course the student should be able to)*

- describe and apply the fundamental concepts used in the field of structural acoustics (wave approach, modal approach, description of damping, etc.),
- apply the equations that describes wave motion in fluids and solids in order to describe wave propagation and reflection/transmission at interfaces between different materials and geometries (e.g. blocking masses, elastic interlayers, junctions)
- describe and evaluate the functioning of numerical tools such as SEA in the field of structural acoustics
- apply SEA for simple cases
- understand and discuss different damping models applied in structural acoustics
- explain the coupling between wave in fluids and solids, along with be able to apply this theory to predict sound radiation from structures in a qualitative and quantitative way,
- use damping treatments such as simple damping layers and sandwich design for noise control problems

Content

- Discrete (lumped) dynamic systems.
- The vibration field and wave types in solids, beams and plates.
- Vibrating finite systems.
- Mobility description
- Modal description of vibrational fields.
- Influence of impedance variation, blocking mass, elastic interlayer
- Damping mechanisms - damping models - damping layers
- Statistical Energy Analysis
- Basic radiators, radiation from vibrating surfaces.
- Integral equations, BE-calculations. Radiation factors.

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Preliminary schedule for the lectures and exercises

31/10	**Properties of a simple mass spring system**, Wolfgang Kropp
1/11	**Wave propagation in continuous systems**, Wolfgang Kropp
2/11	**Waves in infinite structures**, Wolfgang Kropp
7//11	**Waves in finite structures**, Wolfgang Kropp
9/11	**Exercise 1** Hand-out of Assignment A Deadline: 23/11
11/11	**Isolation of structure borne sound**, Wolfgang Kropp
14/11	**Reduction of structure borne sound**, Wolfgang Kropp
15/11	**Reduction of structure borne sound**, Wolfgang Kropp
18/11	**Damping - properties of sandwich constructions**, Wolfgang Kropp
21/11	**Forced Excitation of finite structure,** Wolfgang Kropp
22/11	**Exercise 2** Hand-out of Assignment B Deadline: 6/12
25/11	**Statistical energy analysis,** Wolfgang Kropp
28/11	**Statistical energy analysis,** Wolfgang Kropp
2/12	**Sound radiation**, Wolfgang Kropp
06/12	**Sound, structures and their interaction** (infinite plates), Wolfgang Kropp
07/12	**Exercise 3**, Hand-out of Assignment C Deadline: 21/12
09/12	**Sound, structures and their interaction** (infinite plates), Wolfgang Kropp
12/12	**Numerical description of sound radiation**, Wolfgang Kropp
13/12	**Numerical description of sound radiation**, Wolfgang Kropp
16/12	**Numerical description of sound radiation**, Wolfgang Kropp

Extra consultation time will be scheduled during the course