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## Course programme

### Acoustics VTAN01 (7,5 hp) – Autumn semester 2020

#### Purpose and content

The purpose of the course in acoustics is to give knowledge of sound propagation in different media, namely in fluids such as air and in vibrating systems of solid structural elements, where different wave types (i.e. longitudinal waves, transversal waves and bending waves) can co-exist. Fundamental properties and phenomena involved (i.e. generation, transmission, radiation, reflection and absorption), are introduced as well.

The topics of building acoustics and room acoustics will be extensively dealt with from a practical and theoretical point of view, namely introducing existing calculation models and measurement techniques to address insulation and noise issues. A special focus is put into performing and evaluating sound measurements as well as into concepts of measurement accuracy.

#### Literature and resources

Lecture notes and distributed written materials.

Course website: <http://www.akustik.lth.se/utbildning/kurser/vtan01-akustik-acoustics/>

#### Teachers – Engineering Acoustics

Delphine Bard (DB), [delphine.bard@construction.lth.se](mailto:delphine.bard@construction.lth.se)

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Course responsible, lectures

Lectures, exercises, laboratory sessions

Lectures

Course administration

#### Examination

The course will be examined as follows:

- A project task that will be solved practically and presented both orally and in a written results report.
  - The project will be presented in a “popular-science video” presentation.
- A written exam mostly consisting of problems similar to those from the exercise sessions (calculator and handed out formulae summary are allowed).
- Attended and performed laboratory exercises along with written reports of the results.
- The project task and the exam are both given the grade: “u”, “3”, “4” or “5”, where “u” means not-passed. The final grade is obtained by weighing both grades according to: project (50%) / exam (50%).
  - Practically, the latter means the mean value, and if the result falls between two grades, the grade of the project task and the quality of the lab-reports will decide.
- The lab reports are compulsory to hand in; then pass (not graded) or returned for completion until passed.

For passing the course, the project, the written exam and all laboratory reports must be passed.

#### Learning outcomes

- The learning outcome of the laboratory exercises is to be able to apply provided theoretical models or relations and to provide a solution to a given problem with instructions. Therefore, the laboratory exercises are presented to the students as tasks or problems to be solved. To do so, different theoretical aspects or



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models are to be applied and illustrated by solving structured and well defined problems. In the lab report the relations used and theory behind are to be described and the results given along with estimated errors.

- The written exam contains some theoretical questions but mainly problems similar to those solved during the exercise sessions. The learning outcome is to have knowledge and understanding of the acoustics foundations and phenomena.
- The purpose of the project is to show that the students are able to model and analyse a problem with the tools, models and theories that are introduced during the course. The specific content of the projects is for the students to decide together with the teachers. The final output of the project should be, on top of the usual (i.e. more-technical) report, a “digital product” (in form of a video) where, in a popular scientific way, the task at hand is introduced as well as explained how it has been approached and solved. The idea behind this is to prepare the students for the real world, where rather complicated tasks should be explained to the general public in a simple and understandable way.

## Laboratory exercises

The course contains two laboratory exercises that will be performed:

Lab No.	Content	Date of presentation/hand-in
1	Recording, calibration and evaluation of sound	13 <sup>th</sup> November 2020
2	Sound insulation	04 <sup>th</sup> December 2020

The laboratory exercises take approximately 2 hours to carry out on site. In addition, time will be needed for preparation, calculations, analysis and writing a laboratory report. As the laboratory sessions take place outside the regular course schedule of lectures and exercises, plenty of alternatives with different time slots will be offered to the students to perform the needed measurements during the corresponding week of the lab.

## Project task

Different options will be proposed as possible topics for the project tasks. Likewise, students will also be able to suggest other alternative topics to the teachers which may be accepted. The project tasks will be introduced in the course at week 3, and presented on Wednesday, December 18<sup>th</sup> from 15:00 to 17:00 (in room V:Q1).

## Bibliography

- [1] A. D. Pierce, *Acoustics: An Introduction to Its Physical Principles and Applications*, 3rd Ed., Springer, 2019.
  - [2] T.E. Vigran. *Building Acoustics*. Taylor & Francis Group, 2008.
  - [3] L. Cremer, M. Heckl and B. A. T. Petersson, *Structure-Borne Sound*, Springer, 2005.
  - [4] O. A. B. Hassan, *Building Acoustics and Vibration*, World Scientific, 2009.
- + Lecture notes & Handed out material during class

## Weekly schedule

The course is scheduled Wednesdays 8-10 and 15-17 in V:O1 (occasionally V:Q1) and Fridays 8-10 in V:O1. The scheduled time concerns both lectures (Wednesdays and Fridays) and exercises (Wednesdays). Please note that in the first week (only) the exercise session will be held on Friday instead. Additional time for self-study will be required, as well as to perform project tasks and manage laboratory sessions and exercises.



Week	Date	Course section	Running Priority	Teacher
45 (1)	04/11	- <u>8-10</u> : Course introduction & Basic acoustics	Fix groups and schedule Lab sessions	NV
	04/11	- <u>15-17</u> : Measurement Techniques - <b>Introduction Lab1</b>		NV
	06/11	- <u>8-10</u> : Exercise 1 - Lab1-Part1 (all together: place/time TBA)		NV NV
46 (2)	11/11	- <u>8-10</u> : Wave Propagation	<b>Lab 1 report hand in</b>	NV
	11/11	- <u>15-17</u> : Exercise 2		NV
	13/11	- <u>8-10</u> : Building Acoustics 1 - <b>Presentation results Lab1</b>		NV/MB
47 (3)	18/11	- <u>8-10</u> : Room Acoustics 1		DB
	18/11	- <u>15-17</u> : Exercise 3		NV
	20/11	- <u>8-10</u> : Building Acoustics 2 - <b>Introduction Lab2</b> - Project introduction		NV/MB
48 (4)	25/11	- <u>8-10</u> : Room Acoustics 2	<b>Lab 2 report hand in</b>	DB
	25/11	- <u>15-17</u> : Exercise 4		NV
	27/11	- <u>8-10</u> : Building Acoustics 3		NV
49 (5)	02/12	- <u>8-10</u> : Room Acoustics 3		Guest (EN)
	02/12	- <u>15-17</u> : Exercise 5		NV
	04/12	- <u>8-10</u> : Auralisation - <b>Hand-in Lab2 (no presentation)</b>		Guest (HA)
50 (6)	09/12	- <u>8-10</u> : Calculation methods	Project preparation	NV
	09/12	- <u>15-17</u> : Exercise 6		NV
	11/12	- <u>8-10</u> : Building Acoustics 4		Guest (KH)
51 (7)	16/12	- <u>8-10</u> : Consultation (project or generally course) - <u>15-17</u> : <b>Project presentation</b>	<b>Project presentation</b>	DB/NV/MB
	18/12	- <u>8-10</u> : <i>Exercise RECAP</i>		NV
<b>Exam</b>	11/1	- <b>Exam (Vic: 3C, 3D), 14:00-19:00</b>		