Course PM/syllabus for: **Urban acoustics,** ACE195, 7.5 ECTS Chalmers International Master Programme in Sound & Vibration (MPSOV) Quarter 4: 2023

# Course: Urban acoustics

## Dear student,

The **main goals** of the course are to understand the role and potential qualities of sound and vibration within planning of urban and rural areas as well as to understand the existing engineering prediction methods for community noise and ground vibrations, and to be able to critically judge their use within planning.

The learning outcomes are as follows. After completion of this course, the student should be able to:

- Describe acoustic qualities within urban planning
- Explain the physics behind sound propagation outdoors
- Explain the main properties of environmental acoustics sources
- Explain in detail the sources of road traffic and of rail traffic
- Apply advanced models and tools for the prediction of sound propagation outdoors
- o Describe and utilise standards in the field of sound propagation outdoors
- List typical solutions for urban sound planning and their effect in terms of sound pressure level, sound quality and the functioning of urban spaces
- Describe the relation between the concerns and requirements of urban development, traffic planning, transportation noise and ground vibrations.
- Summarise the behaviour of the wave types and wave propagation in ground vibrations and its practical consequences
- o Interpret measured data and perform calculations to evaluate ground vibrations in urban planning
- Consider sound and vibration in urban planning using a systematic process
- Compare and evaluate different planning options for an urban development site with respect to sound and vibration
- Develop, recommend and motivate an urban design idea for an urban development site, especially with respect to soundscape, noise, ground vibrations and mobility solutions

### Hope you will enjoy the course!

### **Teachers:**

Jens Forssén (JF), tel. 772 8604, email: jens.forssen@chalmers.se Fatemeh Dashti (FD), tel. 772 1871, email: fatemeh.dashti@chalmers.se Astrid Pieringer (AP), email: astrid.pieringer@chalmers.se Wolfgang Kropp (WK), email: wolfgang.kropp@chalmers.se Jiaming Wu (JW), email: jiaming.wu@chalmers.se Andreas Gustafson (AG), email: andgusta@chalmers.se

### **Course assistant:**

Fatemeh Dashti (FD), tel. 772 1871, email: fatemeh.dashti@chalmers.se

### Schedule:

The planned schedule and content are listed below. Updates during the course will be shown in the common schedule, the TA web calendar: <u>www.ta.chalmers.se/education/schedules</u> (look for "URB") (The course follows block schedule C.)

### Lectures and in-class exercises:

According to the schedule. (Updates published in the common schedule, see above.)

### Lecture room:

The lecture room at Applied Acoustics. Some lectures will be given on Zoom (links will be provided on Canvas and in the TA web calendar).

### **Course literature:**

Material developed by the teachers.

Course PM/syllabus for: **Urban acoustics,** ACE195, 7.5 ECTS Chalmers International Master Programme in Sound & Vibration (MPSOV) Quarter 4: 2023

### **Project:**

The project is presented aurally and as a report. The project is made as a group work with the addition of an individual logbook.

## **Examination:**

Written exam and project (4 + 3.5 ECTS). Written exam at end of course (formula sheet and calculator are allowed): grades 3, 4 and 5 correspond respectively to 15, 20 and 25 of the exam's maximum 30 points. The project is also graded (3, 4 and 5 corresponding to percentages 40, 60 and 80). To pass the course, the written exam as well as the project assignment need to be passed. The total grade for the course is given by a weighted average of the points of the two parts. Mandatory parts of the project include, on an individual level, a visit to the project site filling in an acoustic survey questionnaire and updating the logbook and, on a group level, completing hand-in tasks during the course, giving a final presentation of the project and uploading the final project report and presentation slides.

# The scheduled content is listed below as one table per week (for date and time updates see the TA web calendar)

# Below each table the weekly content of the planned Project work is indicated (including expected student working time)

Study week 1				
Date	Activity	Teacher	Study materials	
March 20 13:15-15:00	Lecture (1, Intro)         -       Introduction to the course, course info and info on the project         -       Introduction to planning and the role of acoustics         -       Examples from previous research projects	JF	Prepared by JF	
March 20 15:15-16:00	Lecture (2, Intro, contd) <ul> <li>Introduction to the project</li> </ul>	JF, FD	Prepared by JF	
March 23 08:00-09:45	Lecture (3)         -       Introduction to outdoor sound propagation and community noise.         -       Description of layout of engineering noise mapping model, exemplified by the Nord2000 model         -       Exemplifying Engineering models (CNOSSOS-EU, Harmonoise, Nord2000, ISO-9613)         -       Introducing road source models and the model suggested for use in the project	JF	Prepared by JF	
March 23 10:00-11:45	Project Workshop         –       Introduction to project, continued (JF)         –       Getting started with the project and preparation for site visit (FD)	JF, FD	Prepared by JF	
March 24 15:15-17:00	Project Workshop – Site visit and inventory	FD	Prepared by JF, FD (questionnaire)	
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Project content (student working time: 8 h)

- Info about the project site, aim of project, regulations, stakeholders
- City of Gothenburg's guide to sound planning
- Student work:
- Inventory of existing documents (noise maps, traffic noise inventories, traffic flows, future plans of traffic, etc.) - Start on the Logbook
- Site visit/Questionnaire/Measure with sound level meter

Course PM/syllabus for: **Urban acoustics,** ACE195, 7.5 ECTS Chalmers International Master Programme in Sound & Vibration (MPSOV) Quarter 4: 2023

Study week 2			
Date	Activity	Teacher	Study materials
March 27	Lecture (4)	JF	Prepared by JF
13:15-15:00	<ul> <li>Relation between sound power level and sound pressure level*</li> </ul>		
(On Zoom)	<ul> <li>How to calculate SPL and SPL re free for a point source above hard ground*</li> </ul>		
*View uploaded	<ul> <li>Relation between sound power level of each vehicle and sound</li> </ul>		
videos with	power level per unit length		
derivations	<ul> <li>Equivalent and maximum levels</li> </ul>		
before lecture	<ul> <li>Presentation of Hand-In Task 1 (HIT1)</li> </ul>		
March 27 15:15-16:00 (On Zoom)	<ul> <li><b>Project Workshop,</b> Group work with supervision</li> <li>Work on 'where to place what?', make initial sketches</li> </ul>	FD, JF	
March 30 08:00-09:45	Lecture (Noise mapping software)           –         Demonstration of a noise mapping software SoundPLAN           –         How to get started with using SoundPLAN in the project	AG	Prepared by AG
March 30	Project Workshop, Group work with supervision	FD	
10:00-11:45 (Computer room SB-D209 booked)	<ul> <li>Working with SoundPLAN (incl. creating building objects from sketches)</li> </ul>	AG	
March 31	Project Workshop, Group work with supervision	FD	
15:15-17:00 (Computer room SB-D209 booked)	<ul> <li>Working with SoundPLAN, continued</li> </ul>	AG	

Project content (student working time: 8 h)

- Analysis and conclusion on outcomes of the site visit: questionnaire results, measured noise levels, relation to building regulation, variation within the area, etc.; working on 'where to place what?'.
- Work with noise mapping software
- Update the Logbook and hand in
- Work on Hand-In Task 1 (HIT1)

- EASTER BREAK -

# Course PM/syllabus for: Urban acoustics, ACE195, 7.5 ECTS Chalmers International Master Programme in Sound & Vibration (MPSOV) Quarter 4: 2023

Study week 3				
Date	Activity	Teacher	Study materials	
April 13 08:00-09:45 (On Zoom)	Lecture (5) – Noise annoyance and health. – Indoor noise levels. (Example of façade insulation.) – Outdoor sound propagation: Ground effect, Diffraction	JE	Prepared by JF	
April 13 10:00-11:45 (On Zoom)	Project Workshop, Group work with supervision – Working on project and HIT1.	FD, JF		
April 14 15:15-17:00 (On Zoom)	Lecture (6) – Outdoor sound propagation: Diffraction and ground, Refraction, Atmospheric absorption, and Turbulence	JF	Prepared by JF	

Project content (student working time: 8 h)

- Work on the project
- Update the Logbook
- Hand-in of Task 1, Friday 12:00.
- View video Tutorial on Calculation examples of outdoor sound propagation/road noise

Study week 4			
Date	Activity	Teacher	Study materials
April 17	Lecture ( <i>Traffic</i> )	JW	Prepared by JW
13:15-15:00	<ul> <li>Traffic flow modelling / Road transport planning</li> </ul>		
(Zoom)			
April 17	Project Workshop, Group work with supervision	FD, JF	
15:15-17:00 (Zeem)		and JW (first	
(20011)		nour)	
April 20	Lecture (Tyre-road)	WK	Prepared by WK
10:00-11:45	– Source modelling: Tyre-road interaction		
April 21	Tutorial/Consultation/räknestuga		
15:15-17:00			
(TA Lecture room)	Students working with calculation examples, with supervision/consultation (1 h, FD)	FD	Posted exercise examples and old exams

Project content (student working time: 8 h)

- Including alternative future developments and additional constraints (e.g. closing Eklandagatan east of Gibraltargatan).
- Traffic noise modelling
- Update the Logbook

Course PM/syllabus for: **Urban acoustics,** ACE195, 7.5 ECTS Chalmers International Master Programme in Sound & Vibration (MPSOV) Quarter 4: 2023

Study week 5			
Date	Activity	Teacher	Study materials
April 24	Lecture (Rail 1)	AP	Prepared by AP
13:15-15:00	Sources of rail noise		
April 27	Tutorial/Consultation/räknestuga		
09:00-09:45			
	Students working with calculation examples, with	FD	Posted exercise examples and
	supervision/consultation (1 h, FD)		old exams
April 27	Lecture (Rail 2)	AP	Prepared by AP
10:00-11:45	Sources of rail noise, continued		
April 28	Tutorial	AP	Prepared by AP
15:15-17:00	Calculation examples of Rail noise		
	Presentation of Hand-In Task, HIT2		
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Project content (student working time: 8 h)

- Considering alternative future development in terms of a tram line along Gibraltargatan
- Update the Logbook
- Work on Hand-In Task, HIT2

Study week 6				
Date	Activity	Teacher	Study materials	
May 4	Lecture (Groundvib 1)	FD	Prepared by FD	
09:00-11:45	<ul> <li>Ground vibrations</li> </ul>			
May 5	Lecture/Tutorial (Groundvib 2)	FD	Prepared by FD	
15:15-17:00	<ul> <li>Ground vibrations, continued</li> </ul>			
	<ul> <li>Calculation examples</li> </ul>			
	<ul> <li>Presentation of Hand-In Task, HIT3</li> </ul>			

Project content (student working time: 8 h)

- Choice of group focus
- Continued project work
- Update the Logbook
- Work on Hand-In Tasks

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Study week 7				
Date	Activity	Teacher	Study materials	
May 8	Project Workshop, Group work	FD	Prepared by FD	
13:15-15:00	Working on ground vibration modelling			
May 11	Lecture (7)		Prepared by JF	
10:00-11:45 (Hybrid?)	<ul> <li>Advanced numerical methods for outdoor sound propagation calculations (PE_EEP_ED_TD)</li> </ul>	JF		
(Hybrid:)	<ul> <li>Predicting underwater sound (Guest lecture)</li> </ul>	TJ/CA		
May 12	Project Workshop, Group work with supervision	FD, JF		
15:15-17:00	<ul> <li>Group presentations of concept (informal – in breakout rooms)</li> </ul>			
(On Zoom)	<ul> <li>Working on project and Hand-In Tasks</li> </ul>			

Project content (student working time: 6 h)

- Continued project work
- Update the Logbook
- Conclude and upload the Hand-In Tasks

Study week 8				
Date	Activity	Teacher	Study materials	
May 15 13:15-15:00	<b>Project Workshop,</b> Group work with supervision Working on project	JF, FD		

Project content (student working time: 15 h)

# • Iteration: concept - plan - modelling - check - revise

Study week 9				
Date	Activity	Teacher	Study materials	
May 22 13:15-16:00 Lecture room or Zoom	<ul> <li>Project         <ul> <li>Final presentation of project (15 minutes presentation, 5 minutes discussion)</li> </ul> </li> <li>Format: Slide show presentation: Process, concept, design, modelling, result</li> </ul>	JF, FD		
May 25 09:00-11:45 Lecture room or Zoom	Reserve time			

Project content (student working time: 15 h)

- Continued project work
- Hand-in of report and slide show: May 25, 17:00.

### Exam week

#### Written examination: morning May 30.

Exam week			
Date	Activity	Teacher	Study materials
May 29	Consultation time	FD	
10-11:45			