Chalmers University of Technology - Division of Applied Acoustics

Technical Acoustics 2

VTA091 – 3rd and 4th quarter 2024 – 7.5 credits

Examiner/Teachers:
WK: Wolfgang Kropp (teacher,course administrator, wolfgang.kropp@chalmers.se)
JT: Jannik Theyssen (teacher, jannik.theyssen@chalmers.se
Course literature: The TA1-compendium, notes and material found on the TA2 webpage/and or on the Canvas course page.

Introduction:
TA2 is an advancement and continuation of *Technical Acoustics 1 (TA1)*. It gives the students the opportunity to apply the theoretical frame that is given in *TA1* to a simple, real life structure. The course focuses on analytical and numerical methods for describing vibrations and structure-fluid interaction. For information about the course goals, please study the learning outcomes stated in the syllabus (found on Studentportalen).

Organisation:
The course is divided into three parts: vibration analysis, radiation analysis, and a re-design part. The work is carried out in small groups of two, in exceptional cases three, students. The students will submit a report for each part and summarize their findings in a presentation at the end of the course. Different course assistants will be responsible for different sub-tasks, they will give lectures, provide specifications for the sub-tasks and be available for consultation.

Main course contents:

- Vibration analysis:
  - The wave approach (WK)
  - Finite Element Method (WK, JA)
  - Statistical Energy Analysis – vibration (WK)
- Radiation analysis
  - Boundary Element Method (WK, JA)
  - Statistical Energy Analysis – radiation (WK)
- Re-design part (WK)
  - Identify noise sources
  - Suggest measure(s) and estimate the possible improvements in radiated SPL
  - Finalise your idea in reality and measure the achievements

Content of the reports:
The three reports should cover the following general topics (detailed task instructions for the different methods are given in separate documents available on the course page):

1. Vibration report: An analysis of the vibrational behaviour of the structure using the wave approach, FEM and SEA. The methods shall be compared on a theoretical level, in comparison to measurements, with respect to the quality of the obtained simulation results and the practicality of the methods. Simulation and measurement results shall also be used to analyse the vibrational behaviour of the structure.
2. Radiation report: An analysis of the radiation behaviour of the structure using BEM and SEA. The methods shall be compared on a theoretical level, in comparison to measurements, with respect to the quality of the obtained simulation results and the practicality of the methods. Simulation and measurement results shall also be used to analyse the radiation behaviour of the structure. This report is not intended as a *stand-alone report* but as a shorter *add-on report* to the vibration report. Read on its own the radiation

report does not need to fulfil all requirements of a full report. Together with the vibration report, however, it needs to fulfil these requirements.

3. Re-design report: Important conclusions from the two previous reports, a motivation for your re-design approach, an approved re-design plan, a thorough analysis and discussion of simulated and measured improvements.

Requirements for obtaining a passing grade, or grade 4 or 5:

- Attend the lectures.
- Study the appropriate course material.
- Actively participate in vibration and radiation analysis, and the re-design part.
- Hand in a draft and a final version of a redesign plan.
- Write a report for each of the three course parts. The reports should follow our *Guidelines for Report Writing*, which can be found on the course home page.
    - The reports will be graded is on a quarter scale (U, 2.5, 2.75, 3.0, ..., 5.5), where U is not passed, ≥2.5 is a passing grade, grade 4 is between 3.5 and 4.5, and grade 5 is from 4.5 and above .
    - The requirements for the different grades are outlined below.
    - There is only one hand-in for each report unless the grade is U. In this case a second hand-in with a maximum attainable grade of 3.0 is possible.
- Actively participate in the final oral presentation on the redesign part.
    - This presentation is graded in the same way as the reports.
- For passing the course, each report and the final presentation must reach a passing grade or better.
- The rounded average of the grades of the three reports determine 80 % of the final grade. The remaining 20 % are given by the grade for the final presentation.

Report grading guidelines:

Grade	Requirements
U Not approved	You did severe mistakes in your analysis and the results are very wrong **OR** it is almost impossible to follow your problem analysis, proposed solutions and results in the report.
3	You did some major errors in your analysis, but wrote a fairly good report **OR** You essentially got the right results, but the presentation of your work in the report is very hard to follow. A good report should be concise, not unnecessary wordy.
4	You solved all the tasks with the correct approach and analysis, except for a few major errors. The report is well written and it is easy to understand and interpret your problem, solution strategy, and results **OR** You solved all the tasks with the correct approach and got the correct results, except for a few minor errors, but the report is a little bit hard to read, understand and follow.
5	You solved all the tasks with the correct approach and analysis, possibly with just a few minor errors. The report is well written and it is easy to understand your problem, solution strategy, and interpretation/discussion of the results.

Tentative schedule

Quarter 3

Vibration part

15/1	10–12	Introduction + Lecture: Wave approach (WK)
17/1	13–15	Lecture: Numerical modelling of vibrations + Finite Element Modelling (WK)
18/1	10–12	Finite Element / Comsol (TA)
23/1	10–12	Lecture: Statistical Energy Analysis (WK)
		Consultation on demand (WK, JA)

Deadline for the vibration report: 4/3, 17:00

15/3 10–12 Feedback on vibration report (WK)

Radiation part

5/3	10–12	Lecture: Boundary Element Method (WK)
5/3	13–15	Boundary Element Method /Comsol (JA)
7/3	10–12	Lecture: Radiation calculations using SEA (WK)
		Consultation (WK/JA) on demand

Deadline for the radiation report: 27/3, 17:00

Quarter 4

10/4 13–15 Feedback on radiation report (WK)

Re-design part (all WK)

26/3	13-15	Re-design introduction and brainstorming
10/4	13-15	Discussion of the re-design memo Additional times for support/planning of the implementation report will be scheduled

"Soft" deadline for the re-design memo: 31/3

Deadline for the re-design plan: 10/5, 17:00

Lab times for the re-design part Will be in the TA schedule

29/5 13–15 Final re-design presentations

Deadline for the re-design report: 2/6, 17:00