Aalto University ELEC-E5640 Noise Control L. Exam 19.10.2015

Allowed/required equipment: note-taking equipment, MAOL table book, standard function calculator, student card or ID. No other books, notes, laptops/PDAs. Everyone leaves an answer sheet, even if it only has a name and student number. Remember the acknowledgement to the attendance list. Maximum score 30 p. Determination of grade: 1: 15 p, 2: 18 p, 3: 21 p, 4: 24 p, 5: 27 p.

DO ALL 5 TASKS.

1. The auditorium has 300 seats and the absorption area is 300 m². One intake air valve is placed under each seat. The same amount of air is brought into the auditorium from each place. The sound power level of a single valve for an airflow of 20 l/s is 40 dB (laboratory value). How much airflow can be brought from each valve into the auditorium so that the highest permissible sound pressure level of 20 dB is not exceeded? Hint: Calculate the requirement for the total sound power level, and the requirement for the individual valve and apply the general equation for the flow noise sound power level. In the calculation, a diffuse sound field can be assumed in the room. 6 days

2. Answer the questions verbally and, if necessary, complete with a figure or formula:

a) What is the mass-air-mass resonance frequency, with what kind of structure it occur, and how does it affect the structure's air sound insulation? 1d.

b) List three factors discussed in the textbook that improve the air sound insulation value Rw of a simple board.1d.

c) What initial information is needed when one wants to evaluate the speech transmission index STI in a room? 1d.
d) Define what the reference signal means in active noise suppression. 1d.

e) How is the step sound level improvement DL measured and what is the step sound level improvement number ALw? 1d.

f) In the diagram, it says AL35dB for the facade structure. What exactly does that mean? 1d.

3. Air is removed from the room (10 m²-Sab) with an exhaust air device (KSO 100, page 2). The pressure drop of the exhaust air device is 60 Pa. The exhaust air device is on the wall surface. With the control damper (IRIS 100, page 2), we want to produce a pressure drop of 70 Pa before the exhaust air device, resulting in an airflow of 30 l/s. The calculations are made based on the octave bands 63-2000 Hz. In the noise calculations, only the flow noise of the control damper and exhaust air device is considered.

a) Calculate the sound level LpA in the room caused by the control damper alone. 4 days

b) How much noise reduction is required from the additional silencer placed before the terminal device's total sound level (control damper + terminal device) LpA maximum 0.5 dB? The claim must be proven with calculations. 2 days (minimum attenuation requirement in octaves), if it is desired that the noise of the control damper increases the noise generated in the room, it is located outside at a height of about 2 m above the ground, far from houses. The device operates around the clock and emits sound evenly in all directions. At what distance from the crusher does the limit value of the noise level occur? The environment is open.

4. a) The chip-burning plant uses a crusher with a sound power level of 120 dB during operation. Crusher (2x2x2 m) steady. The task deals with the octave band 1000 Hz and other frequencies are not considered. The environmental noise limit value is Leq, 24h 50 dB. The noise level is considered 2 m above the ground. The earth's surface is hard. Atmospheric absorption is not needed to observe. 3 days.

b) The crusher is only in operation for one hour a day. How does this affect the 24-hour equivalent sound power level and the distance where the limit value is realised? 3 days

5. Structures that separate spaces, such as facades, often consist of many building parts, such as walls, windows, doors and ventilation openings. Joint soundproofing refers to a structure formed by several building parts together soundproofing. Derive the joint sound insulation calculation equation (below). 6p.

$$R_{\text{yhteis}} = 10\lg \frac{\sum_i S_i}{\sum S_i 10^{-R_i/10}}$$

where R; is the airborne sound insulation of building part i [dB] and S; is the area of building part i [m²].

	63	125	250	500	1000	2000	4000	8000
A_i	-26.2	-16.1	-8.6	-3.2	0	1.2	1	-1.1

$$L_p = L_W + 10\log_{10}\left[\frac{k}{\Omega r^2} + \frac{4}{A}\right]; \; L_w = 10\lg S + 10\lg v^n + L_0;$$