Course outline

How does an NPTEL online course work?

MATLAB

Week 1

Week 2

Week 3

Week 4

Week 5

Week 6

Week 7

Week 8

Week 9

- Cross-Flow elements: Setting-up the Equations
- Cross-Flow elements: MATLAB Demonstration for Simple Configurations
- Plug Mufflers, Three-pass Perforated Element Muffler (Commercial Configurations) - MATLAB
- Quiz : Assignment_9
- Feedback For Week 9
- Solution Week_9

Week 10

Week 11

Week 12

Text Transcripts

Live Session

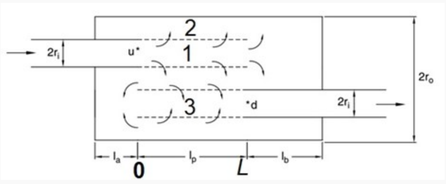
Assignment_9

The due date for submitting this assignment has passed.

Due on 2021-03-24, 23:59 IST.

As per our records you have not submitted this assignment.

1) Consider the cross-flow open-ended expansion element shown below. ***1 point***



For the annular part, or the chamber, the boundary conditions at the $z = 0$ and $z = L$ is given by

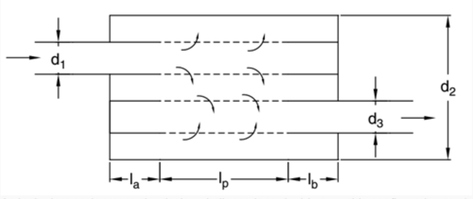
- $Z_2(0) = -jp_0c_0\cot(k_0l_a), \quad Z_2(l_p) = -jp_0c_0\cot(k_0l_b)$
- $Z_2(0) = -jp_0c_0\tan(k_0l_a), \quad Z_2(l_p) = -jp_0c_0\tan(k_0l_b)$
- $u_2(0) = 0, \; u_2(l_p) = 0$
- $p_2(0) = 0, \; p_2(l_p) = 0$

Q.2 to Q. 5 requires the use of MATLAB.

No, the answer is incorrect.
Score: 0

Accepted Answers:
$Z_2(0) = -jp_0c_0\cot(k_0l_a), \quad Z_2(l_p) = -jp_0c_0\cot(k_0l_b)$

2) Consider the three-duct cross-flow expansion chamber muffler shown below ***1 point***



As in the last assignment, the design challenge is to double-tune this configuration to obtain a broadband transmission loss performance. The overall chamber length $L_0 = 500mm$, take $D_1 = D_2 = D_0 = 150mm$, airway diameter $d_0 = 50mm$, and porosity $\sigma = 30\%$, hole diameter and thickness both equal to $3mm$. Consider a stationary medium, and ambient temperature $T_0 = 20$ degrees and assume only planar wave propagation in the chamber and airways. Use the perforate impedance given in the paper by Elnady et al. (Journal of Vibration and Acoustics, ASME 2010) presented in week 8 lecture.

The tuned geometrical lengths L_1 *and* L_2 is approximately given by

- 237 mm, 114 mm
- 250 mm, 125 mm
- 114 mm, 237 mm
- 263 mm, 136 mm

No, the answer is incorrect.
Score: 0

Accepted Answers:
237 mm, 114 mm
114 mm, 237 mm

3) For the muffler configuration shown in Q.2 above, the amount of attenuation produced at the first and second chamber resonance for mean grazing flow $m_g = 0.15$ is given by ***1 point***

- 13.8 dB, 14.8 dB
- 0 dB for both resonances
- 2 dB, 2.5 dB
- attenuation peaks will be produced at these frequencies

No, the answer is incorrect.
Score: 0

Accepted Answers:
13.8 dB, 14.8 dB

4) The design challenge involves choosing between the following muffler configurations: ***1 point***

A two-duct straight-through perforated muffler (see Q. 3 of last assignment, i.e., assignment 8) and a three-duct cross-flow expansion chamber configuration (see figure in Q.2), both of circular cross-sections. Both have the same chamber diameter $D_0 = 150mm$, airway diameter $d_0 = 50mm$, and porosity $\sigma = 30\%$, hole diameter and perforate thickness both equals $3mm$. Take chamber length L = 500 mm for both mufflers.

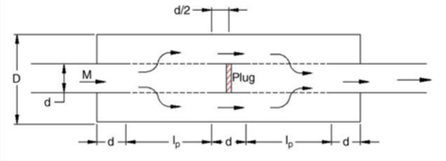
You need to tune the extensions at the inlet and outlet, and decide which one is more suitable, keeping in-mind, that mean flow cannot be ignored and a higher back-pressure can be tolerated. Consider $m_g = 0.15$ in the inlet duct for each muffler.

- Cross-flow muffler is preferred-higher attenuation at axial resonances in presence of flow, and moderately higher back-pressure
- Straight-through muffler is preferred – much lower back-pressure
- Cannot decide – both of them deliver nearly identical attenuation performance

No, the answer is incorrect.
Score: 0

Accepted Answers:
Cross-flow muffler is preferred-higher attenuation at axial resonances in presence of flow, and moderately higher back-pressure

5) Consider the plug muffler configuration shown below. The schematic shows the symbols used to represent different dimensions. ***1 point***



Take chamber diameter $D = 150mm$, airway diameter $d = 50mm$, perforated section length $l_p = 3.5d$, perforate hole diameter and thickness equal to 3 mm and 2 mm, respectively. The grazing flow velocity Mach number M = 0.15 in the airway, and sound speed c0 = 343 m/s.

A new quantity termed as open-area ratio is defined which is given by OAR = perforate area/cross-sectional area of the airway, i.e.,

$$OAR = \frac{4l_p\sigma}{d}.$$

You are allowed to design in such a manner that a very high stagnation pressure drop can be tolerated which implies a low OAR. (Note that OAR equal to 2 or more, renders the plug-muffler ineffective in the presence of flow.) The design value for maximum porosity σ such that transmission loss (TL) is at least 5 dB at troughs in the presence of mean flow $mg = 0.15$ is given by

- 10%
- 5%
- 3.5%
- 20%

No, the answer is incorrect.
Score: 0

Accepted Answers:
3.5%