## Indian Institute of Technology Kanpur

## Proposal for a new course

- 1. Course no: ME XXX
- 2. Course title: Acoustics
- 3. Per week lectures: 3 (L), tutorial: 0 (T), laboratory: 0 (P), additional hours [0--2]: NA (A),
  Credits (3\*L + 2\*T + P + A) = 9
  Duration of course: Full semester
- 4. Proposing department/IDP: Mechanical

Other departments/IDPs which may be interested in the proposed course: Aerospace

Other faculty members interested in teaching the proposed course:

- 5. Proposing instructor(s): Aditya Saurabh
- 6. Course description:

(A) Objectives: Introduce concepts and methods to understand acoustic waves in fluids and

solving associated academic and industrial problems.

(B) Contents (preferably in the form of 5 to 10 broad titles):

S. No.	Broad Title	Topics	Lectures (50 min)
1	Acoustics in fluids — introduction	Sound, fluid momentum and energy, acoustic energy and power, acoustic displacement and velocity, propagation of acoustics, one-dimensional wave equation	2
2	Oscillations and waves	Oscillations, vibratory motion, damped vibrations, forced oscillations, resonance, wave motion, oscillators, coupled oscillators, wave motion and flow of energy in coupled oscillators, waves on strings and membranes	6
3	Wave motion in fluids	Wave motion, energy, momentum, traveling acoustic wave, wave reflection at surfaces and discontinuities, energy loss mechanisms, plane waves, plane wave propagation and attenuation	8
4	Sound sources and radiation	Simple sound source, dipole source, quadrupole and multipole source, acoustic sound generation and radiation from stationary sources, Green's	8

		function for sources, acoustic sound from moving sources, sound generation by flow	
5	Acoustic standing waves	Acoustic transmission lines, non-planar modes, reflections from discontinuities, standing waves in cavities, coupled cavities, reverberation chambers	8
6	Acoustic resonators and passive damping devices	Organ pipe, Rijke tube, Helmholtz resonator, quarter-wave resonator, dissipation at an orifice, acoustic liners, characterization of acoustic devices	7

- (C) Recommended pre-requisites: Undergraduate level fluid mechanics and thermodynamics
- (D) Short summary: The course is designed for students interested in understanding fundamental aspects of acoustics in fluids. The course opens with a discussion on oscillations and waves in general. The discussion is subsequently developed further in the context of acoustics in fluids. The relevant governing equations are developed. Wave propagation and dissipation is discussed. Discussion on sound generation mechanisms and sound sources is taken up next. The special case of standing acoustic waves (as opposed to traveling acoustic waves) which constitutes a large number of practical scenarios is discussed. Finally, the developed framework is applied to practical acoustic devices: resonators and passive damping devices.
- 7. Recommended books:
  - Textbooks: NA
  - Reference books:

Sound and Sources of Sound, Dowling, A. P. and Ffowcs Williams, J. E. F., E. Norwood, 1983 Theoretical Acoustics, Morse, Philip M. and Ingard, K. Uno, Princeton University Press, 1986

8. Any other remarks:

Dated: \_\_13.11.2024\_\_ Proposer: \_\_Aditya Saurabh\_\_

Dated: \_\_\_\_\_\_ DPGC Convener: \_\_\_\_\_

The course is approved/not approved

Chairman SPGC

Dated: \_\_\_\_\_