ACOUSTIC MATERIALS AND METAMATERIALS

PROF. SNEHA SINGH
Department of Mechanical Engineering
IIT Roorkee

TYPE OF COURSE : Rerun | Elective | UG/PG
COURSE DURATION : 8 weeks (18 Jan' 21 - 12 Mar' 21)
EXAM DATE : 21 Mar 2021

PREREQUISITES : Mathematics (up to Class 12th), Physics (up to Class 12th)
INTENDED AUDIENCE : Students and researchers in "Mechanical Engineering, Materials Engineering, Acoustics, Architecture"
INDUSTRIES APPLICABLE TO : ARCI, TATA Advanced Materials Limited, Huntsman Corporation, IACS, Materials Research Society of India (MRSI), Acoustic consultants, Advanced materials manufacturers, Speech transmission industry.

COURSE OUTLINE:
The study of electromagnetic and acoustic waves is an endeavor that dates back centuries. An important sub-domain of this field that effects our daily life is the use of acoustic principles to control environmental noise. In this regard, acoustic materials, which are materials designed to manipulate sound wave propagation, are of prime importance. Within this field, about three decades ago, the concept of metamaterials was proposed that has created a revolution. Theoretical formulation and experiments have shown the feasibility of realizing man-made acoustic metamaterials that can manipulate waves beyond the defined limits of those found in nature. Therefore, within a time span of 15 years, acoustic materials have emerged as an active field driven by scientific discoveries and diverse application potentials in machinery noise control, frequency filtering, speech transmission technology, acoustic imaging, and cloaking. This is the first-ever organized coursework on acoustic materials with a special focus on acoustic metamaterials. This course will cover the following topics:

- Acoustic fundamentals
- Theory and design principles of acoustic barrier materials, sound absorbing materials
- Limitations of conventional materials
- Principles of acoustic metamaterials
- Theory and design principles of membrane type metamaterials, of sonic crystals
- Guidelines for selecting acoustic materials

ABOUT INSTRUCTOR:
Dr. Sneha Singh is an Assistant Professor at MIED, IIT Roorkee. She has obtained Ph.D. from the University of Warwick in 2016 in the area of Automotive Sound Quality. She has obtained B.Tech. (Honours) from IIT Kharagpur in Manufacturing Science and Engineering in 2011. She is an author of 6 international journal papers of high repute and 8 international conference papers.

COURSE PLAN:
Week 1: Acoustics fundamentals, Sound propagation in fluids
Week 2: Advanced concepts in acoustics, Sound signal analysis, Principles of Noise control
Week 3: Acoustic materials, Enclosures, Barriers, Absorbers
Week 4: Porous sound absorbers, Panel absorbers, Helmholtz resonators, Perforated panel absorbers
Week 5: Micro-perforated panel absorbers, Limitations of conventional acoustic materials
Week 6: Acoustic metamaterials, Membrane type acoustic metamaterials
Week 7: Membrane type acoustic metamaterials (cont'd), Introduction to Sonic crystals
Week 8: Sonic crystals (cont'd), Guidelines for material selection