# Acoustic Instabilities in Aerospace Propulsion - Video course

## COURSE OUTLINE

- Introduction to acoustics and combustion driven oscillations.
- Derivation of the wave equation.
- Traveling wave solutions.
- Standing wave solutions.
- Effect of inhomogeneous media on sound propagation.
- Multi-dimensional acoustics.
- Fundamentals of combustion instability.
- Basic principles.
- Rayleigh criteria.
- Instability in solid and liquid rockets, ramjets, gas turbines.
- Pulse combustors.
- Passive and active control of combustion instability.
- Theoretical analysis of combustion instability.
- Modal stablility analysis.
- Nonmodal stability analysis.

## COURSE DETAIL

| S.No | Topics and contents | Number of Lectures |
|---|---|---|
| 1 | Introduction to acoustics and combustion driven oscillations. | 2 |
| 2 | Derivation of the wave equation. | 3 |
| 3 | Traveling wave solutions. | 2 |
| 4 | Acoustic energy corollary. | 1 |
| 5 | Impedance & admittance. | 1 |

NP-TEL

NPTEL

**http://nptel.iitm.ac.in**

Aerospace Engineering

**Additional Reading:**


1. CULICK, F. E. C. (2006) Unsteady motions in combustion chambers for propulsion systems. RTO AGARDograph AG-AVT-039.
2. Morse, P. M., and K. U. Ingard (1965) Theoretical Acoustics, New York, McGraw-Hill.


**Coordinators:**


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| 6 | Standing wave solutions. | 2 |
| 7 | Reflection and transmission. | 2 |
| 8 | Impedance tube technique. | 2 |
| 9 | Effect of area and temperature variation on wave propagation. | 2 |
| 10 | Wave equation in cylindrical co-ordinates and its applications. | 3 |
| 11 | Basic principles of combustion driven oscillations. | 1 |
| 12 | Rayleigh criteria. | 1 |
| 13 | Mechanisms for instability in solid and liquid rockets, ramjets, gas turbines. | 5 |
| 14 | Pulse combustors and their analysis using Galerkin technique. | 3 |
| 15 | Modal analysis. | 4 |
| 16 | Nonmodal stability analysis. | 4 |
| 17 | Passive and active control of combustion instability. | 2 |
| | **Total Number of Lectures** | 40 |

**References:**

L. E. Kinsler, A. R. Frey, A. B. Coppens and J. V. Sanders (2000) Fundamentals of Acoustics, 4th Edition, Wiley.