Course code	Course Name	L-T-P-Credits	Year of Introduction
AO366	AERO ACOUSTICS	3-0–0-3	2016

Prerequisite : Nil

Course Objectives

- To provide an understanding of fundamentals of acoustics, basic terminologies and scales of measurements.
- To emphasise on sound generation, propagation and radiation by fluid flow over the bodies, like aircrafts, as well as high speed jets like rocket exhausts, which pose both engineering and environmental challenges .
- To expose experimental measurements and computational tools

Syllabus

Basic acoustic terminology and definitions - acoustic reference standards and noise regulations - Various sources of noise in aircrafts - Conservation laws and governing equations of fluid mechanics - Duct acoustics sound fields in ducts and wave guides –Noise insulation and absorption – Acoustic materials -Impact of noise levels on humans and environment. - Aircraft noise regulations near airports – important noise measurements and common instruments- Noise control by source modification, transmission path alterations and receiver protection - Introduction to computational aero acoustics.

Expected Outcome

The students will

i. have a basic understanding of sound, its generation and propagation mechanisms
ii. realize the adverse impacts of sound on humans and environment.
iii. have a knowledge of noise regulations
iv. be able to design devices like high speed cars and trains that produce less noise, by both computational methods as well as by experimental techniques.

Text Books:

1) **M.E. Goldstein**, *Aeroacoustics,* 1st Edition, Mc Graw Hill Publications, 1976
2) **R.J. Peters, B.J. Smith and Margret Hollins**, - *Acoustics and Noise Control* , Routledge Publications , London, 2011.
3) **Tarit. K. Bose**, *Aerodynamic Noise – An introduction for physicists and engineers*, Springer Publications, 2013 ISBN:9781461450191

References:

1) **Blackstock, David T**, *Fundamentals of physical acoustics.* John Wiley & Sons, 2000.
2) **Harris C.M**., *Handbook of Noise Contro*l, McGraw Hill Publications 1979.
3) **Kinsler L. E. , A. R. Frey, A. B. Coppens and J. V. Sanders,** *Fundamentals of Acoustics*, 3rd edition, John Wiley and Sons, New York, 1982.
4) **Reynolds D. D.,** *Engineering Principles of Acoustics*, Allyn and Bacon Inc., Boston, 1981.

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Basic acoustic terminology and definitions - Plane waves and harmonic solution - velocity of sound in fluids - relationship between wave length, particle velocities, acceleration	4	15%

	Acoustic energy density and intensity - acoustic impedance associated with fluid flows –	2	
	Logarithmic decibel scales – acoustic reference standards and noise regulations	2	
II	Various sources of noise in an aircraft - noise produced by engine, propellers, fans, combustion chambers,- helicopter rotor noise – noise generated by subsonic and supersonic jets and rocket exhausts	3	15%
	Noise produced by boundary layers on external surfaces- like fins and stabilizers or from sonic boom	3	
FIRST INTERNAL EXAM			
III	Conservation laws and governing equations of fluid mechanics - Lighthill's analogy and derivation of Lighthill's equation –	3	15%
	Noise generated from flow turbulence – sound generation in subsonic and supersonic fluid flow over solid and flexible boundaries -	3	
	Sound radiation from simple sources like monopole, dipole and quadrapoles	2	
IV	Duct acoustics sound fields in ducts and wave guides – property of duct modes -	3	15%
	Cavity noise- turbo-machinery noise and buzz-saw noise - noise suppression devices like mufflers and plenum chambers	2	
	Noise insulation and absorption – Acoustic materials.	2	
SECOND INTERNAL EXAM			
V	Impact of noise levels on humans and environment. Phone and Sone scales -	2	20%
	Perceived noise levels and noise number index - hearing loss index. Aircraft noise regulations near airports – important noise measurements and common instruments.	3	
	Noise control by source modification, transmission path alterations and receiver protection (by illustrative examples)	2	
VI	Brief introduction to computational aero acoustics.	2	20%
	Use of Computational Fluid Dynamics (CFD) solutions to identify acoustic sources which serve as input to solve Lighthill's equations to predict noise levels	2	
END SEMESTER EXAM			

Question Paper Pattern

Maximum marks: 100 Exam duration: 3 hours

The question paper shall consist of three parts

Part A : 4 questions uniformly covering modules I and II. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part B : 4 questions uniformly covering modules III and IV. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part C : 6 questions uniformly covering modules V and VI. Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

Note: In all parts, each question can have a maximum of four sub questions, if needed.