



# FUNDAMENTALS OF THEORETICAL AND EXPERIMENTAL AERODYNAMICS

**PROF. ARNAB ROY**

Department of Aerospace Engineering  
IIT Kharagpur

**TYPE OF COURSE** : New | Core | UG/PG

**COURSE DURATION** : 12 Weeks (24 Jan' 22 - 15 Apr' 22)

**EXAM DATE** : April 23, 2022

**PRE-REQUISITES** : None

**INTENDED AUDIENCE** : Aerospace Engineering/ Mechanical Engineering

**INDUSTRIES APPLICABLE TO** : This course should suit as an introductory Aerodynamics course for new recruits in organizations like National Aerospace Laboratory (NAL), Defence Research and Development Laboratory (DRDL), Aeronautical Development Agency (ADA), Aeronautical Development Establishment (ADE), Hindustan Aeronautics Limited (HAL) and private/ multinational aerospace firms like Boeing, Airbus etc. It should be useful for IAF engineers and pilots as well.

## **COURSE OUTLINE :**

This course is introductory in nature and expected to impart firsthand knowledge of Aerodynamics. It combines fundamentals of theoretical and experimental aspects of Aerodynamics without making it too intense and detailed. After successful completion of this course the student should be well prepared for more advanced courses in the discipline.

With ever increasing use of Aerodynamics in a wide gamut of applications like drones, UAVs, micro air vehicles, automobile aerodynamics, sports aerodynamics, industrial aerodynamics, defence and space, it is essential to understand the basics or quickly refresh the fundamental concepts of Aerodynamics while working on any of the above applications. This course exactly fulfils that need.

I would like to once more emphasize that the primary intention of this course is to create a familiarity about Aerodynamics. It is not intended to prepare someone for research but induce the excitement and enthusiasm to pursue it further.

## **ABOUT INSTRUCTOR :**

I am currently working as Professor at the Department of Aerospace Engineering, IIT Kharagpur. The above weblink provides my research details.<sup>2</sup> I have taught various courses covering Aerodynamics, introductory and advanced courses in CFD<sup>3</sup>. My research interests include computational and experimental fluid dynamics.<sup>4</sup> I have delivered several CFD related invited lectures at GE Aviation JFWTC, Bangalore (2019); CFD Workshop, BITS Pilani Hyderabad campus (2016).

## **COURSE PLAN :**

**Week 1:** Aerodynamics-relevance and applications

**Week 2:** Eulerian and Lagrangian perspectives of flow

**Week 3:** Inviscid and viscous flows- potential flow

**Week 4:** Airfoil geometry, Pressure distribution at an angle of attack ( $\alpha$ )

**Week 5:** Finite wing geometry, Control surfaces on wing, horizontal and vertical stabilizers

**Week 6:** Full Potential Equation and its application, Shock and expansion wave theory

**Week 7:** Computing aerodynamic flows- main steps and resources

**Week 8:** Euler and Navier Stokes equations-II

**Week 9:** Wind Tunnel: experimental tool in Aerodynamics

**Week 10:** Flow visualization techniques, Model design and fabrication

**Week 11:** Measurements involving electronic transducers

**Week 12:** Velocity measurement using Particle Image Velocimetry