Birla Institute of Technology & Science, Pilani
Hyderabad Campus

FIRST SEMESTER 2022-2023
Course Handout Part II

Date: 11-08-2023

In addition to part-I (General Handout for all courses appended to the timetable) this portion gives further specific details regarding the course.

Course No : **AN F311 (3 0 3)**
Course Title : **Principles of Aerodynamics**
Instructor-in-charge : **Dr. Pardha Saradhi**
Instructors : **Dr. Pardha Saradhi**

Scope and objective of the course:

This course covers the first hand fundamentals about aerodynamics, i.e. the study of the flow of air about a body more specifically of an airplane, but much of the aerodynamics in this course is relevant to a wide variety of applications from sail boats to automobiles to birds. This course extends fluid mechanic concepts to the aerodynamic performance of wings and bodies in sub/supersonic regimes.

The students will be able to formulate and apply appropriate aerodynamic models to predict the forces on and performance of realistic three-dimensional configurations; assess the applicability of aerodynamic models to predict the forces on and performance of realistic three-dimensional configurations and estimate the errors resulting from their application; and be able to Perform a computational and experimental aerodynamic analysis and design.

Course Pre/Co- requisite (if any)**& Catalogue / Bulletin Description:** *ME F212 (Fluid Mechanics)*

Text Books:
TB 1: Anderson, J. D., Jr., *Fundamentals of Aerodynamics*, Tata McGraw Hill 2001.

Reference books:
RB 1: Bertin, J. J., *Aerodynamics for Engineers*, Pearson Education, 2002.

Course plan#:

Sl. No.	Learning objectives	Contents	Textbook (TB 1) Chapter No.	No. of lecture(s)
1	Introduction	Airfoils, wings and their nomenclature; lift, drag and pitching moment coefficients; centre of pressure and aerodynamic center, flow similarity, types of flows	Ch. 1	1-5
2	Fundamental Principles	Scalar and vector fields, velocity potential, line, surface and volume integrals, mass, momentum and energy equation	Ch. 2	6-11
3	Inviscid Incompressible Flow	Bernoulli's equation, Laplace Equation, Uniform flows, Source and Sink, Flow over different bodies, , circulation and lift generation, Kutta-Joukovskii theorem	Ch. 3	12-16
4	Incompressible Flow over Airfoils and Finite Wings	Airfoil nomenclature and characteristics, Airfoil Theory, Kutta Condition, Classical Thin Airfoil Theory, Finite Wing characteristics, Biot-Savart Law, Helmholtz Theorem, Prandtl's Theory	Ch. 4-5	17-24
5	Compressible flow	Method of superposition, thin airfoil theory, source and vortex methods. Subsonic compressible flow past airfoils; Critical Mach number, drag divergence Mach number, supercritical airfoils, effect of sweep, area rule.	Ch.7	25-30
6	Subsonic	Full and perturbation velocity potential	Ch. 11	31-33

	Compressible Flow	formulations; Supercritical Airfoils, Prandtl and Glauert compressibility corrections.		
7	Transonic and Supersonic Flow	Transonic flow past airfoils, transonic similarity rules; Supersonic flow past airfoils, linearised supersonic flow, shock expansion method.	Ch. 12	34-36
8	Hypersonic Flow	Hypersonic flows, real gas effects, Newtonian theory, lift and drag in hypersonic flows.	Ch. 14	37-38
9	Viscous Flow	Qualitative aspects, NS Equation, Viscous Flow Energy Equation, Boundary Layer Theory,	Ch. 15, 17	39-42

Evaluation Scheme:

Component	Duration (min.)	Weightage (%)	Date & Time	Nature of Component
Mid sem	90 Min.	30%	14/10 - 4.00 - 5.30PM	Close book
Compre	180 Min.	40%	21/12 AN	Close book
Assignments		15%	Will be announced in class	Open book
Project		15%	Will be announced in class	Open Book

Chamber Consultation Hour: To be announced in the class room.

Notices: All notices concerning this course shall be communicated only through **CMS** (the institute's web based course management system) students are advised to visit CMS regularly for latest updates.

Make-up Policy: Make-up shall be given only to the genuine cases with prior confirmation.

Academic Honesty and Integrity Policy: Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

INSTRUCTOR-IN-CHARGE