Course code	Course Name	L-T-P-Credits	Year of Introduction
AO202	AERODYNAMICS - I	3-1-0-4	2016

Prerequisite: Nil

Course Objectives

- To introduce the concepts of mass, momentum and energy conservation relating to aerodynamics.
- To make the student understand the concept of vorticity, irrotationality, theory of airfoils and wing sections.
- To introduce the basics of viscous flow

Syllabus

Basics of fluid Mechanics-methodology of conformal transformation- Boundary layer and boundary layer thickness, displacement thickness, momentum thickness, energy thickness, shape parameter

Expected Outcome

The students will have

i. an ability to apply airfoil theory to predict air foil performance
ii. a knowledge of incompressible flow
iii. an exposure to Boundary layer theory

Text Books:

1. Houghton, E.L., and Caruthers, N.B., "Aerodynamics for Engineering students", Edward Arnold Publishers Ltd., London, 1989.
2. Anderson, J.D., "Fundamentals of Aerodynamics", MaGraw Hill Book Co., 1999

References:

1. Milne Thomson, L.H., "Theoretical Aerodynamics", Macmillan, 1985
2. John J Bertin., "Aerodynamics for Engineers", Pearson Education Inc, 2002
3. Clancey, L J.," Aerodynamics", Pitman, 1986
4. Kuethe, A.M and Chow, C.Y, “Foundations of Aerodynamics”, Fifth Edition, John Wiley & Sons, 2000.

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Euler equation	2	15%
	incompressible Bernoulli’s equation	2	
	circulation and vorticity	2	
	Green’s lemma and Stoke’s theorem	2	
II	Barotropic flow, Kelvin’s theorem	2	15%
	streamline, stream function, irrotational flow	3	
	potential function, equipotential line	2	

	Elementary flows and their combinations.	4	
FIRST INTERNAL EXAM			
III	Ideal Flow over a circular cylinder,	2	15%
	D'Alembert's paradox, magnus effect,.	2	
	Kutta Jukowski's theorem, starting vortex, Kutta condition	3	
	real flow over smooth and rough cylinders	2	
IV	Cauchy-Riemann relations, complex potential,	2	15%
	methodology of conformal transformation,	2	
	Kutta Jukowski transformation and its applications	2	
	thin airfoil theory and its applications.	2	
SECOND INTERNAL EXAM			
V	Vortex filament	2	20%
	Biot and Savart law,	2	
	bound vortex and trailing vortex, horse shoe vortex,	2	
	Lifting line theory and its limitations.	2	
VI	Boundary layer and boundary layer thickness, displacement thickness, momentum thickness, energy thickness, shape parameter,	2	20%
	boundary layer equations for a steady, two dimensional incompressible flow,	2	
	boundary layer growth over a flat plate, critical Reynolds number	4	
	Blasius solution, basics of turbulent flow.	3	
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.