GUJARAT TECHNOLOGICAL UNIVERSITY

AERONAUTICAL ENGINEERING (01)
AERODYNAMICS I
SUBJECT CODE: 2150107
B.E. 5thSEMESTER

Type of course: Engineering Science.

Prerequisite: Fluid mechanics

Rationale: Aerodynamics is one of the core areas in the field of aviation. The concepts of aerodynamics are vitally important to the aeronautical engineer.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
				Theory Marks			Practical Marks			
L	T	P	C	ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
4	1	0	5	70	20	10	30	0	20	150

Content:

Sr. No	Topics	Teaching Hrs.	Module Weightage
1.	**Fundamentals of Aerodynamics** Airfoil, Types of Airfoils, Airfoil Nomenclature and its characteristics, NACA series, Applications of Airfoils, Aerodynamic forces and moments, Pressure coefficient.	**10**	**15 %**
2.	**Characteristics of Low Speed Airfoil** Effect of incidence on pressure distribution, The lift Curve, Airfoil stalling, Drag, Types of drag, Pitching moment, Spanwise flow variation.	**12**	**25 %**
3	**Incompressible Potential Flow** Bernoulli's theorem for incompressible flow, Measurement of air speed, Errors and Corrections, Measurements of airspeed at higher speed, Angular Velocity, Vorticity and strain, Circulation, Stream function, Velocity potential, Elementary flows: Uniform flow, Source flow, Doublet flow, Vortex flow, Principles of superposition, Combination of uniform flow with a source and sink, Half body, Rankine oval body, Non-lifting flow over circular cylinder, lifting flow over a cylinder, Kutta Joukowky theorem.	**15**	**30 %**
4	**Inviscid Compressible Flow** Introduction, Compressibility, Governing equations for inviscid compressible flow, Total conditions. Normal shock waves: Introduction, Basic normal shock equations, Speed of sound, calculation of normal shock wave properties, Measurements of velocity in compressible flow. Oblique Shock waves and expansion waves: Introduction, Oblique shockwave relations. Supersonic flow over wedges and cones, Shock	**15**	**30%**

	interaction and reflections, shockwave for blunt bodies, Prandtl-Meyer Expansion wave, Shock Expansion theory problems.		

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
40%	**30%**	**20%**	**05%**	**05%**	**-**

Reference Books:

1. Fundamentals of Aerodynamics by J D Anderson Jr., McGraw Hill, Inc
2. Aerodynamics by L J Clancy, Sterling Book House, Indian Edition
3. Aerodynamics for Engineering Students by E L Houghton and P W Carpenter
4. Aerodynamics for Engineers by John J Bertin, Perason Education

Course Outcome:

After learning the course the students should be able to
1. Understand basic terms used in Aerodynamics.
2. Understand the effect of the flow on the aircraft.
3. Comprehend the concept of fluid flow.

List of Tutorial:

1. To study of Fundamentals of Aerodynamics
2. Numerical based on Aerodynamic forces and moments
3. Numerical based on Pressure coefficient, Coefficient of lift and Coefficient of Drag
4. Numerical based on Incompressible Potential Flow
5. Numerical based on Inviscid Compressible Flow
6. To study of flow patterns on an airfoil

Major Equipment:

Supersonic Wind tunnel, Scaled model of Wing, Flat Plate, and Cylinder is needed to perform aerodynamics analysis.

List of Open Source Software/learning website: http://nptel.iitm.ac.in/courses.php

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.