

COURSE CODE	COURSE TITLE	L	T	P	C
1152AE129	Missile Aerodynamics	3	0	0	3

Course Category:

Programme elective

a. Preamble :

The course aims at introducing basic knowledge of the different aerodynamic forces act on a missile and effect of these on the stability of the missile.

b. Prerequisite Courses:

- Compressible flow Aerodynamics

c. Related Courses:

- Rockets and missiles

d. Course Educational Objectives:

- To discuss in general, the history of LTA systems and their configurations
- To understand the principles of aerostatics and their application in designing the airships and aerostats
- To know about the current challenges and future developments of lighter than air systems

e. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Explain the basic knowledge of missile.	K2
CO2	Estimate drag for a given missile	K3
CO3	Understanding the nature of flow over the missile and their effects.	K3
CO4	To understand the aerodynamics effects during launching phase.	K3
CO5	To understand the instability due to aerodynamic forces and methods of control.	K3

f. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	L									
CO2	H	H	M	L				H				
CO3	H	H	H	M		M		H			M	
CO4	H	H	H	M	L	M		H			M	
CO5	H	H	H	H						M		

H- High; M-Medium; L-Low

UNIT I BASICS ASPECTS OF MISSILE AERODYNAMICS 9

Classification of missiles-Aerodynamics characteristics and requirements of air to air missiles, air to surface missiles and surface to air missiles-Missile trajectories-fundamental aspects of hypersonic aerodynamics.

UNIT II MISSILE CONFIGURATIONS AND DRAG ESTIMATION 9

Types of Rockets and missiles-various configurations-components-forces on the vehicle during atmospheric flight-nose cone design and drag estimation

UNIT III AERODYNAMICS OF SLENDER AND BLUNT BODIES 9

Aerodynamics of slender and blunt bodies, wing-body interference effects-Asymmetric flow separation and vortex shedding-unsteady flow characteristics of launch vehicles- determination of aero elastic effects.

UNIT IV AERODYNAMIC ASPECTS OF LAUNCHING PHASE 9

Booster separation-cross wind effects-specific considerations in missile launching-missile integration and separation-methods of evaluation and determination- Wind tunnel tests – Comparison with CFD Analysis.

UNIT V STABILITY AND CONTROL OF MISSILES 9

Forces and moments acting on missiles-Lateral, rolling and longitudinal moments-missile dispersion-stability aspects of missile configuration-Aerodynamic control methods-Jet control methods-Stability derivatives.

TOTAL: 45

REFERENCES:

1. Anderson, J.D., “Fundamentals of Aerodynamics”, McGraw-Hill Book Co., New York, 1985.
2. Chin SS, Missile Configuration Design, McGraw Hill, New York, 1961.
3. Anderson, J.D., “Hypersonic and High Temperature Gas Dynamics”, AIAA Education Series.
4. Nielson, Jack N, Stever, Gutford, “Missile Aerodynamics”, McGraw Hill, New York, 1960.
5. Anderson Jr., D., – “Modern compressible flows”, McGraw-Hill Book Co., New York, 1999.