COURSE CONTENT

VEHICLE AERODYNAMICS								
VII Semester: AERO								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
AAED53	**Open Elective**	3	0	-	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite:								

I. COURSE OVERVIEW:

Aerodynamics plays a crucial role in the design, performance, and efficiency of road vehicles, impacting factors such as fuel economy, stability, handling, and vehicle noise. This course provides an in-depth exploration of the principles, methods, and applications of aerodynamics in the context of road vehicles, covering both theoretical concepts and practical considerations.

II. COURSES OBJECTIVES:

The students will try to learn

I. The fundamental principles of aerodynamics, including flow regimes, drag and lift forces, boundary layers, and flow separation, with a focus on their relevance to road vehicle aerodynamics.
II. The overview of aerodynamic challenges and opportunities in road vehicle design, including the effects of vehicle shape, size, and configuration on aerodynamic performance.
III. The techniques and methodologies used in wind tunnel testing for road vehicles, including model preparation, instrumentation, data acquisition, and analysis

III. COURSE OUTCOMES:

At the end of the course students should be able to:

CO 1 Understand the fundamentals of fluid mechanics and their applications to road vehicles.
CO 2 Apply the principles of aerodynamics to different ground vehicles like cars and vans.
CO 3 Discuss the drag measurement techniques over the ground vehicles using shear stress principles.
CO 4 Infer the flow field over commercial vehicles with drag reduction methodology.
CO 5 Demonstrate the Aerodynamic drag coefficients of different commercial vehicles with flow angularity and yaw angles.
CO 6 Select the wind tunnel testing method and measuring techniques for road vehicles.

IV. COURSE CONTENT:

MODULE-I: INTRODUCTION & FUNDAMENTALS OF FLUID MECHANICS (10)
Introduction: Basic principle, Historical development, Basic shapes, streamlined shapes. Fluid Mechanics- Properties of incompressible fluids: density, viscosity, thermal conductivity, Flow phenomena related to vehicles: External flow, Internal flow. External flow problem: Basic equations for inviscid incompressible flow, Applications: The two-dimensional flow around a vehicle-shaped body. Effects of viscosity: Laminar and turbulent boundary-layer development, Separation, Friction drag, Pressure drag,

MODULE–II: AERODYNAMIC PERFORMANCE OF CARS AND LIGHT VANS (10)
Introduction- Resistance to vehicle motion: Equation of resistance to motion, Analysis of the resistances to motion: Aerodynamic drag - Rolling resistance - Climbing resistance - Acceleration resistance. Performance: Motive force diagram- Acceleration time and elasticity- Top speed, Impact of aerodynamic drag and weight

MODULE–III: AERODYNAMIC DRAG OF PASSENGER CARS (10)
The passenger car as a bluff body - Flow field around a passenger car, Analysis of aerodynamic drag, Global considerations, Components of drag- Procedure- Forebody- Windshield, A-pillar- Vehicle rear ends, Sides, Underside, Wheels and wheel wells, Front spoiler, Rear spoiler Attachments

Drag from flow through the car, Trailers and roof luggage racks, Strategies for aerodynamic development of passenger cars- Detail optimization- Shape optimization- Drag reduction in the course of model improvement measures.

MODULE–IV: COMMERCIAL VEHICLES (09)
Introduction- Tractive resistance and fuel consumption - Drag reduction and fuel consumption, Aerodynamic drag coefficients of different commercial vehicles- Wind influence definition of yaw angle- Characterization of air resistance in actual operating conditions. Reducing aerodynamic drag. Drag minimization on trucks, Minimizing drag of buses and delivery vans.

MODULE–V: WIND TUNNELS FOR AUTOMOBILE AERODYNAMICS (09)
Requirements for a vehicle wind tunnel- Simulation of road driving, Principles of wind tunnel technology, Limitations of simulation, Tests with scale models- Influence of the Reynolds number. Existing automobile wind tunnels. Measuring equipment and transducers, Pressure measurements, Air flow velocity measurements, Temperature measurement, Measurement of aerodynamic coefficients.

V. TEXT BOOKS:

1. Wolf-Heinrich Hucho, “Aerodynamics of Road Vehicles: From Fluid Mechanics to Vehicle Engineering” 1998
2. Thomas Christian Schuetz, “Aerodynamics of Road Vehicles”, Fifth Edition R-430 by, SAE International.

VI. REFERENCE BOOKS:

1. E L Houghton and PW Carpenter, "Aerodynamics for Engineering students", 6th Edition, Edward Arnold Publications, 2012.
2. J. B. Barlow, W. H. Rae, A. Pope, “Low Speed Wind Tunnel Testing”, John Wiley & Sons Publisher, 1999.

VII. ELECTRONICS RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc19_ae02/preview
2. https://www.mooc-list.com/search/node/civil%20aviation

VIII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Tech talk topics
4. Open end experiments
5. Definitions and terminology
6. Assignments
7. Model question paper – I
8. Model question paper - II
9. Lecture notes
10. E-learning readiness videos (ELRV)
11. Power point presentation