

AE-306: Automotive Aerodynamics & CFD										
L	T	P	Credit	Area		CWS	PRS	MTE	ETE	PRE
3	0/1	2/0	4	DEC		15/25	25/-	20/25	40/50	-

**Objectives:** To introduce the student with aerodynamics, computational fluid dynamics, styling of vehicles, heat management of engines and wind tunnel testings

AE-306: Automotive Aerodynamics & CFD		Contact Hours
<b>Unit-1</b>	Aerodynamics for Automobiles - Fluid Properties, Fluid Statics, Measurement of Pressure, Fluid Kinematics, Fluid Dynamics, Euler and Bernoulli Equations, Ns Equations, Dimensional Analysis and Similitude, Viscous Flow, Flow Over Immersed Bodies, Boundary Layer, Production of Lift and Drag, Effect of Aerodynamic Forces on Stability of the Vehicle.	8
<b>Unit-2</b>	Computational Fluid Dynamics - Fundamentals of CFD Basics of Finite Difference and Finite Volume Methods, Boundary Conditions, Initial Conditions, Choice of Turbulence Models, Merits And Limitations of Commercial CFD Tools.	6
<b>Unit-3</b>	Aerodynamic Styling of Vehicles - Effect of Shape and Size of Various Exterior Parts of the Vehicle on the Drag Force, Details of Effect of Shape on Aerodynamics of Various Vehicles: Passenger Car, SUV, Utility Van, Mini Bus, Bus, Cargo, Truck and Towing Vehicle Aerodynamics of Race Cars- AE-Rodynamic Features of Race Cars, Measures to Create Negative Lift, Front and Rear Wings, Stability Consideration, Fluid Flow Over Brakes.	6
<b>Unit-4</b>	Thermal Management in Vehicles - Engine Cooling Requirements, Underhood Cooling, Mechanism of Drag Production by the Cooling System.	8
<b>Unit-5</b>	Experimental Procedure and Facilities - Basics of Wind Tunnels, Types of Wind Tunnels, Instrumentation for Wind Tunnels: Pressure Measurement, Velocity Measurement, Force and Moment Measurement Devices, Flow Visualization, Case Studies of Different Wind Tunnels Used for Vehicle Aerodynamics Experimentation.	8
<b>Unit-6</b>	Aerodynamics for Automobiles - Fluid Properties, Fluid Statics, Measurement of Pressure, Fluid Kinematics, Fluid Dynamics, Euler and Bernoulli Equations, Ns Equations, Dimensional Analysis and Similitude, Viscous Flow, Flow Over Immersed Bodies, Boundary Layer, Production of Lift and Drag, Effect of Aerodynamic Forces on Stability of the Vehicle.	6
<b>Total</b>		42

Reference Books:	
1	Bruce R. Munson, Donald F. Young, Theodore H. Okishi, Fundamentals of Fluid Mechanics, 4th Edition, John Wiley and Sons Inc, 2005, ISBN 0471675822
2	John F. Doughlas, Janusz M. Gasiorek, John A. Swaffield, , Fluid Mechanics, 5th Edition, Prentice Hall, 2006, ISBN 0131292935
3	Hucho W. H., Aerodynamics of Road Vehicles, 4th Edition, SAE- International, 2005, ISBN 0768000297
4	Joseph Katz, Race Car Aerodynamics, Robert Bentley Publishers, Cambridge, 1995, ISBN 0837601428
5	Barnard R.H., Road Vehicle Aerodynamic Design: An Introduction, Mechaero Publishing, March 2010, ISBN 0954073479
6.	Jewel B. Barlow, Willium H. RAE, Alan Pope, Low Speed Wind Tunnel Testing, 3rd Edition, Wiley Interscience, 1999, ISBN 0471557749
7	Holman J.P., Heat Transfer, 8th Edition, Mc Graw Hill Company, Uk, 2001, ISBN 0072406550
8	Steven Daly, Automotive Air-Conditioning and Climate Control Systems, Butterworth Heinemann, May, 2006, ISBN 0750669551

**Course Outcomes**

CO1	To study of basics of Aerodynamics for Automobiles
CO2	To study Fundamentals of CFD Basics of Finite Difference and Finite Volume Methods
CO3	To study Aerodynamic Styling of Vehicles and of Effect of Shape on Aerodynamics of Various Vehicles
CO4	To study Thermal Management in Vehicles - Engine Cooling and Underhood Cooling, Mechanism of Drag Production by the Cooling System
CO5	To study Wind Tunnels, its Types and its Instrumentation with case studies.
CO6	To study Fluid, Fluid Dynamics, Production of Lift and Drag, Stability of the Vehicle.

**CO-PO/PSOMatrix**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	0	0	0	0	0	0	2	2	1	1
CO2	3	3	2	3	1	0	0	0	0	0	0	1	2	1	1
CO3	3	3	3	3	1	0	0	0	0	0	0	2	3	3	2
CO4	3	3	3	3	1	0	0	0	0	0	0	1	3	3	2
CO5	2	2	2	2	2	0	0	0	0	0	0	1	2	2	2