B.E Semester: 6Automobile Engineering
Subject Name: Automotive Aerodynamics(AE605-N-D)
[Dept. Elect.-2]

A. Course Objective:

The course should enable the student to:

- Understand the fundamentals of fluid mechanics related to vehicles.
- Know about the aerodynamics drag of cars.
- Learn about the shape optimization of cars.
- Enhance the knowledge of vehicle handling.
- Understand the principle of wind tunnel technology and measurement techniques.

B. Teaching / Examination Scheme:

Teaching Scheme				Total Credit	Evaluation Scheme					
L	T	P	Total		Theory		Mid Sem Exam	CIA	Pract.	Total
Hrs	Hrs	Hrs	Hrs		Hrs	Marks	Marks	Marks	Marks	Marks
3	0	2	5	4	3	70	30	20	30	150

C. Detailed Syllabus:

Unit No.	Details
1	**Introduction :** Historical developments, fundamental of fluid mechanics, flow phenomenon related to vehicles, external and internal flow problem, resistance to vehicle motion, performance, fuel consumption and performance potential of vehicle aerodynamics.
2	**Aerodynamic drag of cars:** Cars as a bluff body, flow field around car, drag force, types of drag force, analysis of aerodynamic drag, drag coefficient of cars, strategies for aerodynamic development, low drag profiles.
3	**Shape optimization of cars :** Front end modification, front and rear wind shield angle, boat tailing, hatch back, fast back and square back, dust flow patterns at the rear, effects of gap configuration, effect of fasteners. Case studies on modern vehicles.
4	**Vehicle handling:** The origin of forces and moments on a vehicle, lateral stability problems, methods to calculate forces and moments – vehicle dynamics under side winds, the effects of forces and moments, characteristics of forces and moments, dirt accumulation on the vehicle, wind noise, drag reduction in commercial vehicles and racing cars.
5	**Wind tunnels for automotive aerodynamics**: Introduction, principle of wind tunnel technology, limitation of simulation, stress with scale models, full scale wind tunnels, measurement techniques, equipment and transducers, road testing methods, numerical methods.

6	**Introduction to Computational Fluid Dynamics (CFD):** Boundary conditions,Basic discretization – Finite difference method, Finite volume method and Finite element method.

Total hours (Theory):48
Total hours (Practical):32
Total hours:80

D. Lesson Planning:

Sr. No.	Date/Week	Unit	Weight age	Topic No
1	1^{st} ,2^{nd} ,3^{rd}	Unit 1	20%	1,2
2	4^{th} .5^{th} ,6^{th}	Unit 2	20%	3
3	7^{th} , 8^{th} ,9^{th}	Unit 3	20%	4
4	10^{th} .11^{th} . 12^{th}	Unit 4	20%	5
5	13^{th} , 14^{th} ,$15^{th,}$,16^{th}	Unit 5	20%	6

E. Instructional Method & Pedagogy

1	At the start of course, the course delivery pattern , prerequisite of the subject will be discussed
2	Lecture may be conducted with the aid of multi-media projector, black board, OHP etc. & equal Weight age should be given to all topics while teaching and conduction of all examinations.
3	Attendance is compulsory in lectures and laboratory, which may carries five marks in overall evaluation.
4	One/Two internal exams may be conducted and total/average/best of the same may be converted toequivalent of 30 marks as a part of internal theory evaluation.
5	Assignment based on course content will be given to the student for each unit/topic and will be evaluated at regular interval. It may carry an importance of ten marks in the overall internal evaluation.
6	Surprise tests/Quizzes/Seminar/Tutorial may be conducted and having share of five marks in the overallinternal evaluation.

F. List of Practical:

1	To study the effect of angle of attack on Lift and Drag force.
2	To study the loss of energy in wake region behind various models (car, jeep, bus etc.) in the wind tunnel.
3	To draw profile of NACA Aerofoils.
4	To visualize and plot the pattern of flow around anbluff body-object in a fluid stream using Hale-Shaw apparatus.
5	A case study: automobile testing for subsonic air velocity
6	To study viscous supersonic flow including compressible boundary layer and compressible turbulent mixing.
7	Measurements of boundary layer thickness using numerical & analytical solution.

G. Students Learning Outcomes:

1	The student can identify different areas for automotive aerodynamic applications.
2	Can find the applications of all the areas in day to day life.

H. Text Books & Reference Books:

1	Hucho .W.H., “Aerodynamic of Road Vehicles”, Butterworths Co., Ltd., 1997.
2	Fox W. Robert, McDonald T.Alan, Introduction to Fluid Mechanics, Fourth Edition, John Wiley & Sons, 1995.
3	Frank M. White, Fluid Mechanics, Tata McGraw-Hill, Singapore,Sixth Edition, 2008.
4	Frank M. White,Viscous Fluid Flow, Third Edition, McGraw-Hill Series of Mechanical Engineering, 2006.
5	John D.Anderson Jr, Modern Compressible Flow with Historical Perspective, McGraw-Hill, 1990.
6	Pope, “Wind Tunnel Testing”, 2nd Edition, John Wiley & Sons New York, 1974.
7	“Automotive Aerodynamic”, Update SP-706, Society of Automotive Engineers Inc,1987
8	“Vehicle Aerodynamics”, SP-1145, Society of Automotive Engineers Inc ,1996.