



FACULTY OF ENGINEERING & TECHNOLOGY

Effective from Academic Batch: 2022-23

Programme: Bachelor of Technology (Automobile Engineering)

Semester: VIII

Course Code: 202010804

Course Title: Automotive Aerodynamics and Aesthetics

Course Group: Professional Elective Course-VI

Course Objectives: Students will be able to impart basic principles of aerodynamics for the design of vehicle body and importance of aesthetics.

Teaching & Examination Scheme:

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
Lecture	Tutorial	Practical		Internal		External		Total
				Theory	J/V/P*	Theory	J/V/P*	
3	0	2	4	50 / 18	25 / 9	50 / 17	25 / 9	150 / 53

* J: Jury; V: Viva; P: Practical

Detailed Syllabus:

Sr.	Contents	Hours
1	Introduction: Historical development trends, Introduction of air flow, Fundamentals of fluid mechanics :Flow phenomenon related to vehicles, External & Internal flow problems, Resistance to vehicle motion, Performance, Fuel consumption and performance, drag of a simple bodies plate, sphere and streamline bodies, SAE aerodynamic axis system.	5



2	Aerodynamic lift and drag: Aerodynamic Drag: Pressure (form) drag, air resistance opposing the motion of a vehicle, after flow wake, drag coefficient, drag coefficient and various body shapes, base drag, vortices, trailing vortex drag, attached transverse vortices. lift coefficients:vehicle lift, underbody floor height versus aerodynamic lift and drag, Aerofoil lift and drag. Aerodynamic drag reduction and lift control: Profile edge rounding or chamfering, bonnet slop and windscreen rake, roof and side panel cambering, rear side panel taper, underbody rear end upward taper, rear end tail extension, underbody roughness. Aerodynamic lift control: Under body dams, wheel air pattern, partial enclosed wheel air flow pattern, rear end spoiler, and negative lift air foil wings.	12
3	Shape optimization and Handling: Front end modification, front and rear wind shield angle, boat tailing, dust flow patterns at the rear, effects of gap configuration, effect of fasteners. Handling: The origin of force and moments on vehicle, side wind 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.	6
4	Commercial vehicle aerodynamics fundamental: Principle of Commercial Vehicle Aerodynamics, effect of rounding sharp front cab body edges, effect of different cab to trailer body heights with sharp and rounded windscreen leading edges, fore body pressure distribution, effect of a cab to trailer body roof height step. Commercial vehicle drag reducing devices: Cab roof deflectors, yaw angle, cab roof deflector effectiveness versus yaw angle, comparison of drag resistance with various commercial vehicle cab arrangement relative to trailer body height, corner vanes, cab to trailerbody gap, cab to trailer body gap seals, skirting, comparison of various devices used to reduce vehicle drag, effect of trailer load position on a vehicle's drag resistance.	8



5	Wind Tunnels For Automotive Aerodynamics: Wind tunnel testing and measurement: Function, features and types of wind tunnels, types of wind tunnel test sections, divergent and convergent collector in wind tunnel, test sequence, measurement of flow velocity, measurement of flow, measurements of aerodynamic loads using wind tunnel balances. On-road testing and measurements: Drag measurement using Coast down tests, crosswind tests, on-road cooling tests, soiling of windows and chassis parts, on-road measurements of the wind noise.	6
6	Automobile aesthetics: Definition, Design concepts of consumer products, aerodynamic vehicle development process and importance of the aesthetic aspects, technical criteria for aesthetic design of exterior and interior, standard and legal requirements, body/dimensions. Ergonomic considerations, conversions for style, forms, colors. Concept sketching, full sized tape drawing, clay model.	8

List of Practicals / Tutorials:

1	Study terminologies related to vehicle aerodynamics and SAE vehicle aerodynamic axis
2	To understand the fundamentals of road aerodynamic drags and lift.
3	Study the effect of different aerodynamic aids for reduction of vehicle drag and lift.
4	To understand the fundamentals of commercial vehicle aerodynamics
5	To demonstrate the drag reduction aids for commercial vehicles.
6	To understand about the fundamentals of commercial vehicle drag reduction techniques.
7	To understand about different types of car body shape optimization.
8	To understand the function of the wind tunnel for the aerodynamic evaluation.
9	To understand the importance of vehicle body styling process and aesthetics.
10	To identify various technical criteria for aesthetic exterior and interior design.

Reference Books:

1	"Aerodynamic of Road Vehicles", Hucho.W.H., Butterworth's Co., Ltd., - 1997.
2	"Wind Tunnel Testing", A. Pope, John Wiley & Sons, New York - 1974.
3	Automotive Aerodynamic: Update SP-706 - SAE - 1987
4	Product Design and Development, AK Chitale and Gupta, PHI Learning.
5	Aerodynamics of Road Vehicles, Thomas Christian Schuetz, SAE
6	Advanced Vehicle Technology by Heinz Heisler, Elsevier Science & Technology.

Supplementary learning Material:

1	NPTEL Resources.
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Pedagogy:

- Direct classroom teaching
- Audio Visual presentations/demonstrations
- Assignments/Quiz
- Continuous assessment

Internal Evaluation :

The internal evaluation comprised of written exam (40% weightage) along with combination of various components such as Certification courses, Assignments, Mini Project, Simulation, Model making, Case study, Group activity, Seminar, Poster Presentation, Unit test, Quiz, Class Participation, Attendance, Achievements etc. where individual component weightage should not exceed 20%.

Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):

Distribution of Theory Marks						R: Remembering; U: Understanding; A: Application, N: Analyze; E: Evaluate; C: Create
R	U	A	N	E	C	
25	25	25	15	5	5	

Course Outcomes (CO):

Sr.	Course Outcome Statements	%weightage
CO-1	Understand various flow phenomenon related to vehicles.	10
CO-2	Able to predict the drag and lift coefficients in the given body.	25
CO-3	Understand the various optimized shape configurations & aerodynamics in automobiles.	30
CO-4	Understand the relevance of aerodynamic testing.	15
CO-5	Understand the significance of aesthetic considerations.	20

Curriculum Revision:

Version:	2
Drafted on (Month-Year):	June-2022
Last Reviewed on (Month-Year):	
Next Review on (Month-Year):	June-2027