



Government of Karnataka

DEPARTMENT OF COLLEGIATE AND TECHNICAL EDUCATION

Programme	Automobile Engineering	Semester	IV
Course Code	20AT43P	Type of Course	Programme Core
Course Name	Vehicle Body Engineering and Dynamics	Contact Hours	8 hours/week 104 hours/semester
Teaching Scheme	L:T:P :: 3:1:4	Credits	6
CIE Marks	60	SEE Marks	40

1.Rationale: In automobile, the body work is the main structure which protects the occupants and any other payload. Thus, the body engineering plays an important role in construction of body and providing comfort and safety to the passengers. The automobile when rolling on the road is subjected to various types of forces. The main goals are reducing drag and wind noise, minimizing noise emission, and preventing undesired lift forces and other causes of aerodynamic in stability at high speeds. The main goal of this course is to impart skill of vehicle body construction, repair and dynamics of the vehicle which also improves the performance of vehicle.

2. Course Outcomes/Skill Sets: At the end of the course the student will be able to:

CO-01	Identify the body and glass material for a given vehicle type and demonstrate replacement of windshield and vehicle body repair while complying with all necessary safety protocols.
CO-02	Select accessories for a given vehicle and list the right adhesives used to affix them.
CO-03	Check for metal corrosion on structural panel for a given vehicle, prepare corrosion spots and perform spray painting process.
CO-04	Test and troubleshoot or service the air conditioning system of a given vehicle.
CO-05	Design an aerodynamic vehicle body ensuring appropriate load distribution along with ergonomical interiors.
CO-06	Design the steering system, braking system and bus body ensuring appropriate design parameters.

3. Course Content

Week	CO	PO	Lecture (Knowledge Criteria)	Tutorial (Activity Criteria)	Practice (Performance Criteria)
			3 hours/week	1 hour/week	4 hours/week (2 hours/batch twice in a week)
1	1,2	1,4	1. Vehicle body -Need- body styles- Materials. 2. Composite materials- Advantage - types- Application. GRP, FRP, carbon reinforced plastics, insulating materials- need-types- properties. 3. Automotive Adhesives & Sealant - Need-Types, Structural adhesive. Application of Adhesive in Automobile	Refer Table 1	1. Identify and compare different materials in a vehicle body. 2. Practice on using of different adhesives and sealant in vehicle body. Note: Use Personal Protective gears & follow the safety rules.

2	1	1,4	<p>1. Automotive Glass – types- toughened glass, laminated glass, Bullet resistance glass. Difference between Toughened glass, sheet glass & Laminated glass.</p> <p>2. Defrosting of windshield glass. Window winding mechanisms-types- mechanical & electrical.</p> <p>3. Automatic window regulating mechanism and center locking mechanism</p>	Refer Table 1	<p>1. Identify the glass material for a given vehicle. Practice on removing and refitting wind shield glasses.</p> <p>2. Servicing of window regulating mechanisms.</p> <p>Note: Use Personal Protective gear & follow the safety rules.</p>
3	1		<p>1. Vehicle body repair - Identification of location of parts and panels. Techniques/ procedure required to Repair of body panel, minor and major structural damage.</p> <p>2. Damages on chassis and body- diamond type, banana damage, twist damage, mash damage, dents and scratches, weld burrs.</p> <p>3. Body & chassis alignment- Reasons & effects.</p>	Refer Table 1	<p>1. a) Remove and refit body panels, doors, floors and fenders.</p> <p>b) Demonstrate different processes for removing dents.</p> <p>2. Checking and correcting the body and chassis alignment</p> <p>Note: Use Personal Protective gears & follow the safety rules.</p>
4	3	1,4	<p>1. Body painting- objectives – Paint types. Elements of paint-pigment- resins- solvents.</p> <p>2. Paint drying process-Types-drying principle of each type.</p> <p>3. Composition & functions- primer paint- putty paint.</p>	Refer Table 1	<p>1. Practice on removing paint from the damaged area, practice on mixing and applying body filler.</p> <p>2. Practice on applying primer, practice on feather edge sanding and masking.</p> <p>Note: Use Personal Protective gears & follow the safety rules.</p>

5	3,5	1,4,7	<p>1. Spray painting - Types, air spray painting-procedure.</p> <p>2. Corrosion: Causes and effects of corrosion on automobile bodies. Methods of corrosion protection.</p> <p>3. Interior aesthetics: -Introduction, Seat ergonomics, seat belt -need-types. seat adjustment mechanisms.</p>	Refer Table 1	<p>1. Practice on cutting, scuffing, rubbing and polishing in painting.</p> <p>2. Demonstrate and practice on anti - corrosion and rust prevention procedure on vehicle body.</p> <p>Note: Use Personal Protective gears & follow the safety rules.</p>
6	4	1,4	<p>1. HVAC system - Functions- Working of vehicle air condition system and its layout</p> <p>2. Construction and working of expansion valve and Accumulator/ drier.</p> <p>3. Working of heating and ventilation system in automobile.</p>	Refer Table 1	<p>1. Air conditioner maintenance and service using automatic AC refilling machine.</p> <p>2.HVAC system troubleshooting.</p>
7	5	1,4	<p>1.Body Dynamics: Different types of engines and drive location with their merits and demerits.</p> <p>2. Different resistance to body motion. Wind resistance, rolling resistance and gradient resistance.</p> <p>3. Power required for propulsion. Traction and tractive effort. Surplus power, acceleration, gradability, draw bar pull, Equivalent weight.</p>	Refer Table 1	<p>1. Case study on load distribution of a vehicle under different conditions (on level road and while ascending the hill). or Using the simulation software examine on load distribution of a vehicle under different conditions</p> <p>2. Case study on resistance to vehicle motion and surplus power of different wheel drive.</p>

8	5	2,4	<p>1.Maximum acceleration, max tractive effort, reactions for front wheel, 4 wheel and rear wheel drive.</p> <p>2.Simple Problems.</p> <p>3. Simple Problems.</p>	Refer Table 1	<p>1.Find different performance parameters of a given vehicle by analytical method using its specification and compare it with actual parameters.</p> <p>2. Using the simulation software examine the different performance parameters of a given vehicle.</p>
9	5		<p>1. Vehicle Aerodynamics: Objectives, aerodynamic forces and moments.</p> <p>2. Various body optimization techniques for minimum drag.</p> <p>3. Various body design features to improve safety. Sources of noise and vibration- various noise and vibration reduction techniques.</p>	Refer Table 1	<p>1.Case Study on determining different type of flow on vehicle body and effects of aerodynamic forces and moments on vehicle body.</p> <p>Or</p> <p>Observe the aerodynamic drag forces using simulation software /set up.</p> <p>2. Practice on Sources of body noises testing and methods of elimination. Water leakage test.</p>
10	6	2,4	<p>Braking System:</p> <p>1.Different forces acting on the vehicle moving on a level road and gradient - when-front wheel brakes applied,</p> <p>2. Different forces acting on the vehicle moving on a level and gradient- when rear wheel brakes applied and all wheel brakes applied.</p>	Refer Table 1	<p>1.Case study on load distribution of a vehicle under different conditions while braking.</p> <p>Or</p> <p>Using the simulation software examine load distribution of a vehicle</p>

			3. Weight transferred during braking, stopping distance, stopping time and efficiency of brakes.		under different conditions while braking. 2. Case study on weight transfer, stopping distance and time improvement under various conditions. Or Using the simulation software examine the weight transfer, stopping distance and time improvement under various conditions.
11	6	2,4,7	Steering System: 1.True steering, over steering, under steering, minimum turning circle radius of vehicle. 2. Collapsible steering column- types, - Construction and working. 3. tilt-telescopic steering columns- construction and working.	Refer Table 1, Study the latest technological changes in this course in this course and present the impact of these changes on industry.	1.Finding minimum turning radius- analytical/ practical method. 2.Demonstration of different types of collapsible steering. Or Using the simulation software analyse the working of collapsible steering column.
12	6	2,4,7	1. Bus Body Details: Types, Bus Body Lay Out: Floor height, engine location, entrance and exit location. 2. seating dimensions, Dimensions of driver's seat in relation to controls, driver's cabin design.	Refer Table 1 Study the latest technological changes in this course	1.Practice on checking of frame alignment and its correction. 2. Practice on Bus body dent removal and painting.

			3. Constructional details: Frame construction, Double skin construction-Types of metal section used-Regulations-Conventional and Integral type construction.	in this course and present the impact of these changes on industry.	Note: Use Personal Protective gears & follow the safety rules.
13	5	2,4,7	1. Wind tunnels for automotive aerodynamics: Introduction – Principles of wind tunnel technology. 2. Flow visualization techniques. Testing with wind tunnel balance (scale models). 3. Road Testing -Need-Equipment used in road testing. Crash test- need- types- Equipment needed- government regulation- rating.	Study the latest technological changes in this course and present the impact of these changes on industry.	1. Case study on Analysis of flow visual technique. Case study on wind tunnel technology. Or Using the simulation software analyse the flow visual technique. 2. Case study to improve safety rating of a given vehicle.
Total in hours			39	13	52

* PO= Program Outcome as listed and defined in year 1 curriculum and PO – CO mapping with strength (Low/Medium/High) has to be mapped by the course coordinator. (Above only suggestive)

Table 1: Suggestive Activities for Tutorials: (The List is only shared as an Example and not inclusive of all possible activities of the course. Student and Faculty are encouraged to choose activities that are relevant to the topic and on the availability of such resources at their institution)

Sl. No.	Week	Suggested Activity
1	1	Study advantages of plastics and Aluminum over other body materials. List and present all the Aluminum body materials used in a given car.
2	2	Study and demonstrate various tools used in body repair.
3	3	Present on “Modern techniques of painting a car”.
4	4	Visit a nearby car paint shop to witness corrosion coating and painting process and record the details and present it as an assignment.
5	5	Refer any one journal paper and present on corrosion prevention techniques on vehicle bodies.
6	6	Study and present on different types of air conditioner refrigerants and the effects on atmosphere.
7	7	Study car dashboard and car interior decoration, suggest innovative dashboard with neat sketch.
8	8	Study on weight distribution of a vehicle during braking and prepare a report on how the weight is transferred during braking.
9	9	“Does a car really need spoiler?” justify your answer. Install a spoiler to given car in a suitable place considering aerodynamics.

10	10	Study air resistance & rolling resistance losses. Suggest and present remedies to prevent these losses.
11	11	Study and present importance of shape optimization in racing cars.
12	12	Visit a manufacturing industry and witness the working of a wind tunnel and present the report based on the study and submit as an assignment.

4. CIE and SEE Assessment Methodologies

Sl. No	Assessment	Test Week	Duration In minutes	Max marks	Conversion
1.	CIE-1 Written Test	5	80	30	Average of three tests 30
2.	CIE-2 Written Test	9	80	30	
3	CIE-3 Written Test	13	80	30	
4.	CIE-4 Skill Test-Practice	6	180	100	Average of two skill tests 20
5	CIE-5 Skill Test-Practice	12	180	100	
6	CIE-6 Portfolio continuous evaluation of Activity through Rubrics	1-13		10	10
Total CIE Marks					60
Semester End Examination (Practice)			180	100	40
Total Marks					100

5. a) Format for CIE written Test

Course Name	Vehicle Body Engineering and Dynamics	Test	I/II/III	Sem	III/IV
Course Code	20AT42P	Duration	80 Min	Marks	30

Note: Answer any one full question from each section. Each full question carries 10 marks.

Section	Assessment Questions	Cognitive Levels	Course Outcome	Marks
I	1			
	2			
II	3			
	4			
III	5			
	6			

Note for the Course coordinator: Each question may have one, two or three subdivisions. Optional questions in each section carry the same weightage of marks, Cognitive level and course outcomes.

5. b) CIE Skill Test-I Scheme of Evaluation

SL. No.	CO	Particulars/Dimension	Marks
1	1	One question on "Vehicle body materials & Vehicle body repair." a) Identification of the material type - 10 m b) Removing & Refitting/ repair -20 m	20
2	1,2	One question on "glass materials, refitting and adhesives".	20

		a) Identification of the material type - 10 m b) Removing & Refitting/ repair -20 m	
3	3	One skill- oriented question on “metal corrosion and painting” a) Safety precautions followed - 5 b) Identification of problem -10 c) Servicing/ Coating/ Painting -10	25
4	4	One question on “air-conditioning cooling system”. a) Identification of defects - b) Troubleshooting/ Servicing `	25
5	1,2,3,4	Portfolio evaluation of practical sessions (1-6 week)	10

5. c) CIE Skill Test-II Scheme of Evaluation

SL. No.	CO	Particulars/Dimension	Marks
1	5	Question on body dynamics a) Demonstration of the given case based on case study/Simulation technique - 15 m b) Identification of the key points - 05 m	20
2	5	One question on “aerodynamics and wind tunnel”. c) Demonstration of the given case based on case study/Simulation technique - 15 m d) Identification of the key points - 05 m	20
3	6	One skill-oriented question on braking system/bus body/ steering system. a) Analyzing the problem - 10m b) Troubleshooting/ simulation technique - 30m	40
4	5,6	Viva-voce	10
5	5,6	Portfolio evaluation of practical sessions (7-12 week)	10
Total Marks			100

6. Rubrics for Assessment of Activity (Qualitative Assessment)

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	Students Score
		2	4	6	8	10	
1		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	8
2		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	6
3		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	2
4		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	2
Average Marks= (8+6+2+2)/4=4.5							5

Note: Dimension and Descriptor shall be defined by the respective course coordinator as per the activities

7. Reference:

Sl. No.	Description
1	Vehicle body engineering by Giles J Pawlowsky (Business books limited)
2	Vehicle body layout and analysis by John Fenton (Mechanical Engg.Publication ltd, London.)
3	Aerodynamics of Road Vehicles by W.H. (Butter worth's 1987)
4	Automobile Engineering (Paint Technology) Vol V by Anil Chhikara, Satya Prakashana New Delhi
5	Automotive Engineering (Heating & Air conditioning) class room manual, Mark Schnubel, Cengage Learning
6	A. Pope - "Wind Tunnel Testing" - John Wiley & Sons - 2nd Edition, New York - 1974.
7	Vehicle maintenance and Garage practice by jigar A. Doshi, Dhruv U. Panchal, Jayesh P. Maniar.
8	Siemens NX 2019 for Designers, 12 Edition by Prof. Sham Tickoo, Purdue University Northwest, USA. (Tickoo-CADCIM Series)
9	Beginning MATLAB and Simulink: From Novice to Professional by Sulaymon Eshkabilov.
10	MATLAB and SIMULINK for Engineers by Agam Kumar Tyagi
11	Siemens NX 2021 for Designers, 14th Edition by Prof. Sham Tickoo, Purdue University Northwest

8. SEE Scheme of Evaluation

SL. No.	CO	Particulars/Dimension	Marks
1	1,6	<p>One question on "Vehicle body materials& type and repair/glass materials and refitting."</p> <p>a) Identification of the material type - 10 m</p> <p>b) Removing & Refitting/ repair -20 m</p> <p>Or</p> <p>One skill-oriented question on braking system/bus body/ steering system.</p> <p>a) Analyzing the problem - 05m</p> <p>b) Troubleshooting/ simulation technique - 25m</p>	30
2	2,3,4	<p>One skill- oriented question on "adhesive/metal corrosion / painting"</p> <p>a) Safety precautions followed - 5</p> <p>b) Identification of problem -10</p> <p>c) Servicing/ Coating/ Painting -25</p> <p>Or</p> <p>One skill- oriented question on "air condition system"</p> <p>a) Safety precautions followed - 5</p> <p>b) Identification of problem -10</p> <p>c) Servicing - 25</p>	40

3	1,2,3,4,5,6	Viva-voce	20
5	1,2,3,4,5,6	Portfolio evaluation of practical sessions (1-13 week)	10
Total Marks			100

9. Equipment/software list with Specification for a batch of 20 students

Sl. No.	Particulars	Specification	Quantity
1	Four-wheeler with all body fittings and accessories.		1
2	Mini-Bus with all body fittings and accessories.		1
3	Body repair Equipment.		2
4	Body repair tool kit		2
5	Arc welding transformer up to 300 Amps with attachments and welding shields.		1
6	Gas welding machine with attachments and oxygen and acetylene cylinders.		1
7	Single action sander		1
8	Dual action sander		1
9	Dent repair kit		1
10	Magnetic Dent puller kit		1
11	Aluminum suction cup		1
12	Glue tab dent pullers		1
13	Polishing and buffing machine		1
14	Fully Automatic car AC servicing equipment		1
15	Paint booth		1
16	Spray painting equipment.		2
17	Vehicle AC demo kit.		2
18	Simulation software (Siemen's NX), any simulation software		10