GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)

Semester -III

Course Title: **Vehicle Body Engineering**

(Course Code: 4330205)

Diploma programme in which this course is offered	Semester in which offered
Automobile Engineering	3rd

1. RATIONALE

As a diploma graduate in automobile engineering, one is supposed to supervise fabrication and repair work of various vehicle bodies. The knowledge and skills of vehicle body technology is required for vehicle body fabrication and repair work. In the automotive field auto body repair is experiencing a faster growth than any other service area. Collision repair plus the normal upkeep of the automobile body requires increasing numbers of well-trained auto body technicians. This course is designed to provide students the required level of knowledge and skills of vehicle body technology.

2. COMPETENCY

The course content should be taught and curriculum should be implemented with the aim to develop different types of skills leading to the achievement of the following competency.

- **Plan and Supervise vehicle body repair work with sustainable approach**.

3. COURSE OUTCOMES (COs)

The underpinning knowledge and the relevant skills associated with this competency are to be developed in the student to display the following COs:

a) Explain vehicle body construction.
b) Use various body repair tools and equipment with proper safety measures.
c) Select appropriate body material for specific body part considering sustainability.
d) Practice vehicle body repairs and replacement at different levels.
e) Plan different surface finishing processes and rectify the defects of painting.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
2	0	2	3	30*	70	25	25	150

(*): Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessing the attainment of the cognitive domain UOs required for the attainment of the COs.

Legends: ***L****-Lecture;* ***T*** *– Tutorial/Teacher Guided Theory Practice;* ***P*** *- Practical;* ***C*** *– Credit,* ***CA*** *- Continuous Assessment;* ***ESE*** *- End Semester Examination.*

5. SUGGESTED PRACTICAL EXERCISES

The following practical outcomes (PrOs) that are the sub-components of the COs. *These PrOs need to be attained to achieve the COs.*

Sr. No.	Practical Outcomes (PrOs)	Unit No.		Approx. Hrs. required
1	Observe & identify body interior and exterior parts and explain their function.	I	Any one	04
2	Observe & identify and make a note on aerodynamic concepts and ergonomic concepts used in given four-wheeler.	I		04
3	Check & perform body dimensioning by using various Measuring tools.	II	Any one	04
4	Demonstrate Body Aligning process of deformed vehicle structure with the help of body aligners.	II		04
5	Observe any particular vehicle for its all body parts and make a list of alternate and ecofriendly material for that body parts.	III		02
6	Perform dent repair process with hand tools and power tools.	IV	Any Three	04
7	Perform door fitting and servicing.	IV		04
8	Demonstrate minor damage repairs with washer welder method and panel shrinking method.	IV		04
9	Demonstrate panel replacement method for damaged /rusted panels.	IV		04
10	Perform Fiber Glass repairs for damaged bumpers.	IV		04
11	Demonstrate dismantling of upholstery, accessories, electrical window and seat operating equipment of vehicle.	IV		04
12	Demonstration of paint preparation and different paint techniques.	V		04
13	Demonstrate different body coating processes.	V		02
	Total			**28**

Note

i. *More **Practical Exercises** can be designed and offered by the respective course teacher to develop the industry relevant skills/outcomes to match the COs. The above table is only a suggestive list.*

ii. *Care must be taken in assigning and assessing study report as it is a first-year study report. Study report, data collection and analysis report must be assigned in a group. Teacher has to discuss about type of data (which and why) before group start their market survey.*

iii. *The following are some **sample** 'Process' and 'Product' related skills (more may be added/deleted depending on the course) that occur in the above listed **Practical Exercises** of this course required which are embedded in the COs and ultimately the competency.*

(For practical at sr. no. 1, 2 & 5)

Sr. No.	Sample Performance Indicators for the PrOs	Weightage in %
1	Identification of parts/material and concepts.	20
2	Explain function/ importance of the given parameter in a vehicle.	20
3	Questions-Answer	30
4	Make a note elaborating all details precisely.	30
Total		**100**

(For practical at sr. no. 3, 4 & 6 to 13)

Sr. No.	Sample Performance Indicators for the PrOs	Weightage in %
1	Understanding of the assigned work and process plan for assigned work.	20
2	Select appropriate method and tools for body work.	20
3	Proper use of available resources and accuracy in work followed by Safety measures.	30
4	Make a note elaborating all details precisely.	30
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

These major equipment with broad specifications for the PrOs is a guide to procure them by the administrators to usher in uniformity of practical in all institutions across the state.

Sr. No.	Equipment Name	PrO. No.
1	Latest car	1,2 & 5
2	Hand tools-Mallets, dolly blocks, files, spoons, picks /Power tools-Dent puller, sander, slide hammer T Bar Puller Tool Car Dent Remover and grinder.	6
3	Wheel Base Gauge, Tram Tracking Gauge, Centering gauge, Caroliner bench, inside/ outside micrometers, Vernier calipers, dial gauges, depth gauges, steel rulers, T-squares, flat edges, calipers, dividers and protractors.	3
4	Body aligners-Manual OR Electronic.	4
5	Door/Bumper stand, Door skin tool, hinge kit	7
6	Hot stapler welding gun, stapler or car bumper repair kit	10
7	Washer welder kit, heat torch,	8
8	Air saw, cutters, welding kit, metal cutting gun, Trim removal tools	9
9	Pick hammers and punches, caulking guns, adhesive brushes, and mallets, Holding tools: various clamps, holding jigs,	11
10	Power sanders, spray guns, air compressor.	12,13
11	Coating kit	13

12	Pre-used/Replaced/Salvage parts of vehicle parts for practical performance and demonstration.	1 to 13
13	Gloves, Safety shoes, goggles, ear plugs, boiler suits, Fire Extinguishers, First aid kit, safety ventilation equipment	1 to 13

7. AFFECTIVE DOMAIN OUTCOMES

The following ***sample*** Affective Domain Outcomes (ADOs) are embedded in many of the above-mentioned COs. More could be added to fulfil the development of this course competency.

a) Work as a leader/a team member.
b) Follow ethical practices.
c) Practice environment friendly methods and processes. (Environment related)

The ADOs are best developed through the field based exercises/project work. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

i. 'Valuing Level' in 1st year
ii. 'Organization Level' in 2nd year.
iii. 'Characterization Level' in 3rd year.

8. UNDERPINNING THEORY

The major underpinning theory is given below based on the higher level UOs of *Revised Bloom's taxonomy* that are formulated for development of the COs and competency. If required, more such higher level UOs could be included by the course teacher to focus on attainment of COs and competency.

Note*: The UOs need to be formulated at the 'Application Level' and above of Revised Bloom's Taxonomy' to accelerate the attainment of the COs and the competency.*

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
Unit I Fundamentals of Vehicle Body Construction	1.a Differentiate chassis, frame &body. 1.b Explain different methods of body construction and various body styles. 1.c Identify and explain functions of various exterior &interior parts of a vehicle body. 1.d Classification of bus body and commercial vehicles. 1.e Explain necessity and concept of aerodynamics in vehicle body shape. 1.f Explain vehicle ergonomics concepts in body design.	1.1 Introduction to chassis, frame and body with their classifications. 1.2 Different methods of vehicle body construction. Various vehicle body styles. Integral body construction (safety body cell & crumple zone) 1.3 Vehicle body interior and exterior parts, their location and function. 1.4 Classification of bus bodies based on distance travelled, capacity, style andshape. 1.5 Classification of commercial vehicleswith their types and uses. 1.6 Introduction to vehicle aerodynamics. Different types of aerodynamic shapes. 1.7 Principle of Ergonomics in

		vehicle body building. Driver seat & driver's visibility.
Unit II Vehicle Body Repair Tools (Hand Tools, Power Tools, Measuring Tools and Body Aligners)	2.a Select and use the appropriate hand tools, power tools and equipments for vehicle body repairs with appropriate safety measures. 2.b Check & perform Measuring & marking by using various Measuring & Marking tools following safety precaution. 2.c Demonstrate safety in vehicle body shop.	2.1 Hand tools for vehicle body repairs (Hammers, Dolly blocks, Spoons, files, body pullers, Washer welder, Power lock stand, Door repair stand, Vise grip pliers, Body repair tool set, Body repair Mechanics stand). 2.2 Power tools for vehicle body repairs (Pneumatic cutting tools [Air chisel, Air saw], Grinders [Air chuck grinder, Power disc grinder, Air disc grinder, Sunform tools], Sanders [Air disc sander, Belt sander, Double action sander, Orbital action sander, Sander with guide, Straight line sander], Cutters and Drill [Spot cutter, Special spot remover air drill, Spot cutter sharpener, Hemming tool]. 2.3 Measuring tools for vehicle body repairs (Wheel Base Gauge, Tram Tracking Gauge, Centering gauge, Dataliner bench, Caroliner bench) 2.4 Vehicle body Aligners – Manual and Electronic Aligners (Bench type, Floor type, Platform type, Intermediate type) 2.5 Safety in vehicle body shop.
Unit III Vehicle Body Materials.	3.a Describe various materials used in vehicle body components. (on which and why basis) 3.b Explain different types of automotive glasses, their locations and their installation methods. 3.c Explain Use of ecofriendly, recycled and reuse material in vehicle body construction.	3.1 Characteristics and types of body building material (Sheet Metal, Glass, Resins, Plastic parts, Composite materials, GRP (glass reinforced plastic), FRP (fiber reinforced plastic), Wood. 3.2 Automotive Glasses 3.3 Introduction to ecofriendly materials in vehicle body building-interiors andexteriors. 3.4 Sustainability in automobile industry by recycling and reusing body building materials.

Unit IV Vehicle Body Repairs-Major, Minor and Miscellaneous Repairs	4.a Demonstrate routine inspection and inspection of overall damage to vehicle body and chassis components based on type of collision. 4.b Plan sequential body repair/replacement procedures. 4.c Demonstrate use of frame straightening equipment and realignment procedures. 4.d Demonstrate glass fitting, door fitting and service, Panel repairing/replacement processes during major collision repairs. 4.e Demonstrate upholstery work. 4.f Demonstrate interior and exterior trimming process of vehicle. 4.g Perform inspection of repaired vehicles.	4.1 Types of collision and related damages. 4.2 Inspection of damaged body and chassis components to find out level of damage. 4.3 Repair procedures based on level of damage. 4.4 Planning of repair work. 4.5 Frame straightening and realignment procedures along with various anchoring methods and ensure the structural integrity of the vehicle and occupant safety. 4.6 Fiber glass repairs & replacement. 4.7 Door service and miscellaneous repairs. 4.8 Panel filling with plastic body andfiller-forming with solder. 4.9 Panel shrinking (drawing operation) 4.10Body aligning and panel replacement. 4.11 Repair with hammer and dolly. 4.12 Upholstery work. 4.13 Interior trim, Exterior trim. 4.14 Inspection of repaired vehicles for proper functioning and dimensional accuracy.
Unit V Painting and Refinishing	5.a Describe various paints, painting techniques and painting equipment. 5.b Describe surface preparation for Painting/Repainting process. 5.c Describe Paint Defects, causes & corrections 5.d Demonstrate process of buffing and burnishing in Automobiles. 5.e Explain and apply Corrosion Protection methods. 5.f Explain body insulation, sealing and coating.	5.1 Paint types & characteristics 5.2 Painting equipment 5.3 Painting methods & techniques (Spraying and Immersion) 5.4 Painting/repainting procedure with surface preparation. 5.5 Different types of paint defects occurring during painting & immediately after drying along with their causes & remedies. 5.6 Surface Refinishing processes. 5.7 Effect of corrosion and corrosion protection methods for rusted parts. 5.8 Requirements and application of

	5.g Compare Ecofriendly paints with regular paints.	Corrosion protection methods. 5.9 Body insulation, coating and sealing. 5.10 Introduction to Ecofriendly paints, its composition and benefits.

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Fundamentals of Vehicle Body Construction	6	7	7	-	14
II	Vehicle Body Repair Tools (Hand Tools, Power Tools, Measuring Tools and Body Aligners)	5	5	5	4	14
III	Vehicle Body Materials.	3	3	2	2	07
IV	Vehicle BodyRepairs- Major, Minor and Miscellaneous Repairs	8	6	7	8	21
V	Painting and Refinishing	6	4	5	5	14
	Total	28	25	26	19	70

Legends: *R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)*

Note*: This specification table provides general guidelines to assist student for their learning and to teachers to teach and question paper designers/setters to formulate test items/questions to assess the attainment of the UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may slightly vary from above table.*

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of each activity. They should also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a) Charts can be prepared.
b) Small report on any topic given by concern faculty.
c) Small groups of students can be formed for assigned work. Assigned work should be such that it covers market survey, team work, presentation, time management, quality development.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a) Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.

b) Guide student(s) in undertaking micro-projects.

c) ***'L' in section No. 4*** means different types of teaching methods that are to be employed by teachers to develop the outcomes.

d) About ***20% of the topics/sub-topics*** which are relatively simpler or descriptive in nature is to be given to the students for ***self-learning***, but to be assessed using different assessment methods.

e) With respect to ***section No.10***, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.

f) Guide students on how to address issues on environment and sustainability

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project is group-based. However, in the fifth and sixth semesters, it should be preferably being ***individually*** undertaken to build up the skill and confidence in every student to become problem solver so that she/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should be about **14 -** ***16 (fourteen to sixteen) student engagement hours*** during the course. The student ought to submit micro-project by the end of the semester to develop the industry-oriented COs.

A suggestive list of micro-projects is given here. This has to match the competency and the COs. Similar micro-projects could be added by the concerned course teacher:

1. Prepare chart according to classification of vehicle body shape with suitable images.
2. Charts on material used for different vehicle body part.
3. Small report on ergonomic principle used in designing vehicle body.
4. Small report on ergonomic principle used in designing vehicle body.
2. Prepare chart showing classification of commercial vehicles with suitable images.
3. Prepare chart demonstrating safety measures in body shop and paint shop.
4. Prepare charts showing different vehicle body tools with their function.
5. Collect data of recycled, reused vehicle body material from an authorized workshop.
6. Collect data of waste management from an authorized workshop.
7. Prepare a door service model with the help of old vehicle door.
8. Prepare a panel for surface preparation practice using an old body part.
9. Prepare a display board of paint tools in disassembled mode. (Use of old equipment suggested)
10. Arrange a group discussion on "Latest body repair trends".
11. Observe and prepare a report on "Work Flow Rate in Body repair shop in 6days" based on extent of damage.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year and ISBN
1.	Automobile Engineering-Body Repair Techniques Vol-IV	Anil Chhikara	Satya Prakashan, New Delhi ISBN-10: 8176840769 ISBN-13: 978-8176840767
2.	Automobile Engineering-Paint Techniques Vol-V	Anil Chhikara	Satya Prakashan, New Delhi ISBN-13: 9788176840774
3.	Vehicle Body Engineering	J. Powlowski	Century ISBN-10: 0220689164 ISBN-13: 978-0220689162
4.	Automotive Refinishing	Harry T. Chudy	Pearson; 3rd edition ISBN-10: 0130100730 ISBN-13: 978-0130100733
5.	Vehicle body layout and analysis	John Fanton	Mechanical Engineering Publications (1980) ISBN:- 0852984456
6.	The Principles of Auto body repairing and Repainting	Alexander Tait, Andre G. Deroche, Nicholas N. Hildebrand	Pearson; 6th edition ISBN-10: 013440033X ISBN-13: 978-0134400334
7.	The Haynes Automotive Body Repair & Painting Manual	Haynes	Delmar Cengage Learning; 1 Edition ISBN:- 1850104794
8.	The Repair of Vehicle Bodies	Andrew Livesey, Alan Robinson	Routledge, 7th Edition ISBN-10: 081537870X ISBN-13: 978-0815378709
9.	Materials for Automobile Bodies	Geoffrey Davies	Elsevier Science ISBN: 9780080969794
10.	Vehicle Body Engineering	A. K. Babu	Khanna Book Publishing ISBN-10: 9390779014 ISBN-13: 978-9390779017

14. SOFTWARE/LEARNING WEBSITES

a) https://www.howacarworks.com
b) https://swayam.gov.in
c) https://auto.howstuffworks.com
d) https://nptel.ac.in/courses
e) https://tinyurl.com/bdcm6a9e for video link
f) https://tinyurl.com/yc7s5evc for web link

15. PO-COMPETENCY-CO MAPPING

Semester III	Vehicle Body Engineering(4330205)						
	POs						
Competency & Course Outcomes	**PO 1 Basic & Discipline specific knowledge**	**PO 2 Problem Analysis**	**PO 3 Design/ development of solutions**	**PO 4 Engineering Tools, Experimentation &Testing**	**PO 5 Engineering practices for society, sustainability & environment**	**PO 6 Project Management**	**PO 7 Life-long learning**
Competency • Plan and Supervise vehicle body repair work with sustainable approach.	3	2	1	2	3	3	3
a)Explain vehicle body construction.	3	-	1	-	1	1	3
b) Use various body repair tools and equipment with proper safety measures.	3	-	-	3	-	2	3
c) Select appropriate body material for specific body part considering sustainability.	3	2	2	-	3	1	3
d) Practice vehicle body repairs and replacement at different levels.	3	3	2	3	2	2	3
e) Plan different surface finishing processes and rectify the defects of painting.	3	1	2	2	2	2	3

Legend: '**3'** for high, '**2**' for medium, **'1'** for low and **'-'** for no correlation of each CO with PO.

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

Sr. No.	Name and Designation	Institute	Contact No.	Email
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