	Course Title: **Vehicle body Engineering**	Course Code: **15AT54C**
	Credits (L:T:P) : 4**:0:0**	Core/ Elective :Elective
	Type of course: : **Lectures**	Total Contact Hours: **52**
	CIE 25 Marks	**SEE 100 Marks**

Prerequisites: Knowledge of Automobile Engineering-I & II, Chassis & Transmission Control.

Course Objectives:

Categorize types of body styles and explain the construction of different types of vehicle body and vehicle air conditioning.

On successful completion of the course, the students will be able to attain CO'S:

Course Outcome		CL	Linked PO	Teaching Hrs
CO1	Illustrate the different types and components of car body.	**U/A**	2	12
CO2	Explain the concept, importance and testing of aerodynamics in car body design.	**R/U/A**	2,6	08
CO3	Illustrate the different types and components of bus and commercial body.	**R/U/A**	2	10
CO4	Explain different vehicle body materials with their merits and demerits.	**R/U/A**	2,6	06
C05	Explain the concept of painting and painting process in car body.	**U/A**	2	08
CO6	Describe the concept and importance of Air conditioning in Automobiles.	**R/U/A**	2,5,6	08
		Total sessions		**52**

Legend: R: Remember, U: Understand A: Application

COURSE-PO ATTAINMENT MATRIX

Course	Programme Outcomes									
	1	2	3	4	5	6	7	8	9	10
Vehicle Body Engineering	**0**	**3**	**0**	**0**	**1**	**3**	**0**	**0**	**0**	**0**

Level 3- Highly Addressed, Level 2-Moderately Addressed, Level 1-Low Addressed.

Method is to relate the level of PO with the number of hours devoted to the COs which address the given PO.

If ≥40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 3

If 25 to 40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 2

If 5 to 25% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 1

If < 5% of classroom sessions addressing a particular PO, it is considered that PO is considered not-addressed.

COURSE CONTENT AND BLUE PRINT OF MARKS FOR SEE

Unit No	Unit Name	Hour	Questions to be set For SEE			Marks Weightage (%)
			R	U	A	
1	Car Bodies	12	---	15	20	23
2	Vehicle Aerodynamics	08	05	05	10	15
3	Bus And Commercial Vehicle Body	10	05	15	15	20
4	Body Materials	06	05	05	05	12
5	Body Painting	08	---	10	10	15
6	Automotive Air conditioning	08	05	10	05	15
	Total	**52**	**145**			**100**

Legend: R; Remember, U: Understand A: Application

Course Delivery: The course will be delivered through lectures, presentations, classroom discussions, and videos.

Course content:

UNIT I: CAR BODIES 12Hrs

Car body-purpose-requirements-Types, Dimensional regulations-concept, driver's visibility-concept- tests for visibility-Methods of improving visibility, space in cars-concept-methods of improving space, Safety- safety design, safety equipments for car, Car body construction-components of car body-purpose of each component, Doors-types, window actuating mechanisms-types-construction and working, Door locks-types, central locking-concept-working principle, general unitary body construction process.

UNIT II: VEHICLE AERODYNAMICS 08Hrs

Aerodynamics-concept-Objectives-Vehicle drag-definition-types-effects, forces and moments acting on vehicle body-types-effects, various body optimization techniques for minimum drag. Wind tunnel testing-concept-types-test setup-testing process- Flow visualization techniques- scale model testing-Component balance to measure forces and moments.

UNITIII: BUS AND COMMERCIAL VEHICLE BODIES 10Hrs

Types, Bus body layouts of each type, Bus Body Lay Out-Floor height-engine location-entrance and exit location-seating dimensions, Constructional details-Frame construction-types-Types of metal section used-Regulations, Double skin construction-concept, Conventional and Integral type construction-concept-merits-demerits, Commercial Vehicle body- Types- illustration of each type, Light commercial vehicle body- types-illustration of each type, Dimensions of driver's seat in relation to controls, driver's cabin design.

UNIT IV: BODY MATERIALS **06Hrs**.

Body material -Requirements-Steel sheet, timber, plastics, GRP, CRP-properties of materials-applications in vehicle body, Interior materials-requirements-types-applications, Glasses-types, laminated glass-concept-purpose, defrosting in glasses-concept-purpose.

UNIT V: BODY PAINTING **08Hrs**

Painting-concept-objectives, elements of paint-resins-concept-function, pigment- concept-function, solvent- concept-function -Types, paint drying process-Types-drying principle of each type-merits-demerits, composition &functions- primer paint- putty paint- surface-sealer - top coat, spray painting- Types, air spray painting-procedure, air less spray painting-procedure, electrostatic painting-procedure, New vehicle painting with a block diagram.

UNIT VI: AUTOMOTIVE AIR CONDITIONING **08Hrs**

Air conditioning- concept, humidity-concept, Automobile air conditioner-layout - functions of each component, refrigerant- metering devices-types, Expansion valve-construction and working, fixed orifice tube-construction and working, Refrigerant –Definition-types-Properties-effect on environment.

REFERENCES:

Sl.No.	Title of Books	Author	Publication
1.	Automotive Engineering (Heating & Air conditioning) class room manual	Mark Schnubel Cengage Learning	Cengage Learning.
2.	Automobile Engineering vol VI(Air Conditioning System)	Anil Chhikara	Satya Prakashana New Delhi
3	Automobile Engineering	Ramalingam K.K	
4	Automobile Engineering vol IV	Anil Chhikara	Satya Prakashana New Delhi
4.	Vehicle Body Repair James Duffy	J.M.Duffy	Cengage Learning
5	Automobile Engineering (Paint Technology) vol V	Anil Chhikara	Satya Prakashana New Delhi
6	Vehicle Body Engineering	Powloski. J.,	
7	Body construction and design	Giles. J.C	
8	Vehicle Body layout and analysis	John Fenton	Mechanical Engg Publication Ltd., London, 1982
9	Vehicle Body building and drawing	Braithwaite.J.B	Heinemann Educational Books Ltd., London
10	*Automotive Mechanics*	Grouse W and Anglin D	Tata Mcgraw Hill Publication 10th edition, 2004

Student Activities/assignment to be performed to award five marks in continuous internal evaluation:

1. Collect information on different vehicle bodies with photographs and specifications.
2. Collect information on different tools and equipments used in body repair shops.
3. Collect information on different paint components used in car body painting shops.
4. Collect information on different advanced body repair process.
5. Collect information on different advanced paints and painting process.
6. Collect information on servicing of car air conditioning system.

Note:

1. Student should prepare a hand written report on any one of the above/similar activity, which helps in achieving above course outcomes.
2. The report prepared should be approved by the concerned staff and HOD.
3. The activity group should consist of maximum of three students.

MODEL OF RUBRICS /CRITERIA FOR ASSESSING STUDENT ACTIVITY

RUBRICS MODEL

Student Name :				Reg No:		
RUBRICS FOR ACTIVITY(5 Marks)						
	Unsatisfactory	**Developing**	**Satisfactory**	**Good**	**Exemplary**	**Student Score**
	1 Mark	**2 Mark**	**3 Mark**	**4 Mark**	**5 Mark**	
Collection of data	Does not collect any information relating to the topic	Collects very limited information; some relate to the topic	Collect much information; but very limited relate to the topic	Collects some basic information; most refer to the topic	Collects a great deal of information; all refer to the topic	Ex: 4
Fulfill team's roles & duties	Does not perform any duties assigned to the team role	Performs very little duties but unreliable.	Performs very little duties	Performs nearly all duties	Performs all duties of assigned team roles	5
Shares work equally	Always relies on others to do the work	Rarely does the assigned work; often needs reminding	Usually does the assigned work; rarely needs reminding	Normally does the assigned work	Always does the assigned work without having to be reminded.	3
Listen to other Team mates	Is always talking; never allows anyone else to speak	Usually does most of the talking; rarely allows others to speak	Talks good; but never show interest in listening others	Listens, but sometimes talk too much	Listens and speaks a fair amount	2
Average / Total =marks=(4+5+3+2)/4=14/4=3.5=4						

Note: This is only an example for one student. Appropriate rubrics/criteria may be devised by the concerned faculty (Course Coordinator) for assessing the given activity.

Course Assessment and Evaluation Scheme:

Method	What		To whom	When/Where (Frequency in the course)	Max Marks	Evidence collected	Course outcomes
Direct Assessment	CIE(Continuous Internal Evaluation)	IA	Students	Three IA Tests; (Average of three Tests)	20	Blue books	1,2,3,4,5,6
				Activities	05	Activity reports	1,2,3,4,5,6
	SEE (Semester End Examination)	End Exam		End of the course	100	Answer scripts at BTE	1,2,3,4,5,6
Indirect Assessment	Student Feedback on course		Students	Middle of the course		Feedback forms	1,2 & 3 Delivery of course
	End of Course Survey			End of the course		Questionnaires	1,2,3,4,5 & 6 Effectiveness of Delivery of instructions & Assessment Methods

Note: I.A. test shall be conducted for 20 marks. Average marks of three tests shall be rounded off to the next higher digit.

Note to IA verifier*: *The following documents to be verified by CIE verifier at the end of semester

1. Blue books (20 marks)
2. Student suggested activities report for 5 marks evaluated through appropriate rubrics.
3. Student feedback on course regarding Effectiveness of Delivery of instructions & Assessment Methods

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FORMAT OF I A TEST QUESTION PAPER (CIE)

Test/Date and Time	Semester/year	Course/Course Code	Max Marks
Ex: I test/6 th weak of sem 10-11 Am	VI SEM	**Vehicle Body Engineering**	20
	Year:2016-17	Course Code:15AT54C	

Tractors and Agricultural implements for tractors

	Question	MARKS	CL	CO	PO
1	List requirements of car body. OR List types of doors with their merits.	05	A A	01	2
2	Explain visibility regulations OR Explain the safety design aspects of a car	05	U U	01	2

3	Explain the various flow visualization methods OR Discuss the various types of drag force and its contribution towards the overall drag force	10	U/A	02	2,6

Note: Internal choice may be given in each CO at the same cognitive level (CL).

MODELQUESTION PAPER (SEE)

VI Semester Diploma Examination

Vehicle body Engineering {Elective Theory}

[MaxMarks**:100]** **[**Time:**3 Hours**]

Note: Answer any **SIX** from Part A and any **SEVEN** from Part B

Part A 6x5=30marks

1. Discuss the different methods of improving visibility.
2. Define drag force, List out the various forms of drag.
3. Explain the various body optimization techniques for minimum drag.
4. State the possible locations of engine in a bus body layout.
5. Explain the influence of the floor height in the bus body layout.
6. List out the points to be considered while designing a driver's seat.
7. List the salient features of FRP.
8. Explain the usage of timber in vehicle body construction.
9. List out the desirable properties of plastic.

Part B 7X10=70 Marks

1. Explain in details the construction of car body with neat sketches.
2. List the salient features of limousine with a neat sketch.
3. Draw the layout of four door saloon and also specify its salient features.
4. Discuss the various types of drag force and its contribution towards the overall drag force.
5. Explain in detail the influence of engine, entrance and exit location in bus body design with relevant sketches.
6. Explain the constructional details of a tanker body.
7. Describe the painting process to be carried out in vehicle body with a schematic representation.
8. Explain the process of electro static spray painting of vehicle with sketch.
9. a. Define Refrigerant and list different types.
   b. Sketch and label any one type of expansion valve.
10. a. Explain the functions of condenser and evaporator.

b. Explain the functions of compressor and dehydrator.

MODEL QUESTION BANK

CO-1: UNIT-I CAR BODIES

05 MARKS

1) List the silent features of limousine. R
2) List the purpose of car body. R
3) List requirements of car body. A
4) Write the classification of car bodies. A
5) State the importance of downward visibility. A
6) Explain visibility regulations? U
7) Discuss the different methods of improving visibility. U
8) List types of doors with their merits. A
9) Explain scissor type window actuating mechanism. A
10) Write a short note on central locking system. A
11) Compare unitary body construction to conventional body construction .A
12) Explain the safety design aspects of a car U

TEN MARKS

1. List the salient features of limousine with a neat sketch. A
2. Draw the layout of four door saloon and also specify its salient features. A
3. Sketch the layout of an estate car. A
4. Explain in details the construction of car body with neat sketches. U
5. Discuss the methods of improving downward, forward and rearward Visibility of car with relevant sketches. U/A
6. Explain any three safety gadgets used in a car U/A
7. Describe in detail the usage of safety equipments in cars U

CO-1I: VEHICLE AERODYNAMICS

FIVE MARKS

1) Define drag force, List out the various forms of drag R
2) Write short note on Aerodynamics. A
3) State different flow visualization techniques R
4) Define the term yawing, Rolling &Pitching R
5) Explain the various body optimization techniques for minimum drag U
6) Sketch the typical wind tunnel and label the parts. A
7) Write a short note on scale model testing. A

TEN MARKS

1) Explain the various flow visualization methods U
2) With a neat sketch explain the construction and operation of a low speed wind tunnel U/A
3) Discuss the various types of drag force and its contribution towards the overall drag force U/A

CO-1II: BUS AND COMMERCIAL VEHICLE BODIES

FIVE MARKS

1. State the possible locations of engine in a bus body layout? R
2. Explain how the exit and entrance location influences the bus body layout A
3. Explain what do you mean by double skin construction? U
4. Explain the influence of the floor height in the bus body layout? U
5. List the advantages of two level single deck buses. A
6. List the types of metal sections used in body construction. R
7. Compare integral and conventional body construction. A
8. Discuss the usage of different metal sections in body construction .A
9. Explain the constructional details of s conventional bus body. U
10. List the advantage of integral bus body. A
11. List out the points to be considered while designing a driver's seat. A
12. Illustrate the seating dimensions for the driver of tanker body. A
13. Draw the layout the driver seat of a forward control vehicle. U/A
14. Write the classification of light commercial vehicle bodies. A
15. Explain the important aspects of tanker body. U/A
16. List out the major factors to be considered in a tipper body design. A
17. List the different types of a commercial vehicle body .R

TEN MARKS

1. Explain in detail the influence of engine, entrance and exit location in bus body design with relevant sketches. U.
2. Explain the integral type of bus body construction with a neat sketch. A
3. Explain the constructional details of a tanker body. A
4. Explain the constructional details double Decker bus body. A

CO-1V: BODY MATERIALS

FIVE MARKS

1. List the salient features of FRP R
2. List the salient features of GRP R
3. List the salient features of CRP R
4. List out the body trim items. R
5. State the advantages of GRP. A
6. Explain the usage of various types of glass and rubber in vehicle body construction.U
7. Explain the usage of timber in vehicle body construction. U
8. List out the desirable properties of plastic. A
9. List types glasses used in Automobile. R
10. Explain construction of laminated glass. U

11. Write a short note on heated glass. A

TEN MARKS

1. Explain the properties and uses of various materials that are being commonly used in the construction of vehicle bodies. U
2. Explain the properties and uses of sheet steel, timber and GRP as vehicle body materials.U

CO-V: UNIT-IV BODY PAINTING

FIVE MARKS

1. Explain the need of primer in painting process. A
2. List the objects of painting. R
3. List out the different types of vehicle body corrosion. R
4. Explain the step by step procedure of vehicle body painting process. U
5. Explain the various anti corrosion methods. U
6. Explain the purpose of pigment and resin in painting process U
7. Explain the purpose putty paint on top coat. U
8. Compare different methods of painting. A
9. Write a short note on paint drying process. A

TEN MARKS

1. Describe the painting process to be carried out in vehicle body with a schematic representation. U/A
2. Explain the process of painting of new vehicle with block diagram U/A
3. Explain the process of airless spray painting of vehicle with sketch. U/A
4. Explain the process of electro static spray painting of vehicle with sketch. U/A

UNIT VI: AUTOMOTIVE AIR CONDITIONING

FIVE MARKS

1. Define Refrigerant and list different types. R
2. List the properties of an ideal refrigerant. R
3. List various components of air conditioning system. R
4. Explain various types of Evaporators. U
5. Explain any one Automatic Temperature control device. U/A
6. Write a note on refrigerant recovery, recycle and recharging. A
7. Sketch and label any one type of expansion valve. A
8. Explain the functions of metering device and fixed orifice tube. U
9. Explain the functions of condenser and evaporator. U
10. Explain the functions of compressor and dehydrator. U

TEN MARKS

1. Explain the construction and working of Automotive Air conditioning system with a layout. A
2. Explain the construction and working of expansion valve with a sketch. A