

GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

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

Course Title: **Automobile Transmission & Mechanism**
(Course Code: 4330202)

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

1. RATIONALE

The power developed by automobile engine is transmitted to the wheels through many parts & mechanisms such as clutch, gear Box, propeller shaft and differential. The entire system is called power transmission mechanism in automobile. It is therefore essential for automobile engineer to acquire knowledge of vehicle layout, transmission system, suspension systems and stability control systems of automobiles. This course is helpful for learner to understand basic fundamentals of transmission system, identifying and locating components of automotive transmission system. This course is pre-requisite for maintenance and service-II.

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.

- **Apply knowledge of construction and working of vehicle transmission and stability control system.**

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) Identify various layout of Chassis-Frame and related power train system
- b) Explain the construction and working of power train system.
- c) Describe need and working of driveline components and various axle assemblies.
- d) Explain the construction and operation of direction and stability control system.
- e) Explain construction and operation of comfort and stability systems.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
L	T	P		Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
3	0	2	4	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.*

S. No	Practical Outcomes (PrOs)	Unit No.		Approx. Hrs. required
1	Classify various types of chassis & frames and draw different types of layouts for power flow from engine to wheels.	1	Any one	2
2	Identify vehicle layout and chassis of given vehicle.	1		2
3	Identify various parts/ components of an automobile clutch and illustrate its working mechanism for given clutch.	2	Any Two	4
4	Identify various parts/ components of an automobile gearbox and illustrate its working mechanism for given gear box.	2		4
5	Draw power flow line diagram for forward and reverse gear of 5+1 synchromesh gear box.	2		4
6	Illustrate working of overdrive and differential.	2,3		4
7	Identify various parts / components of propeller shaft and universal joints and illustrate its working mechanism.	3	Any One	4
8	Identify various parts/ components of axles and illustrate its working mechanism for given axle. (live axle and Dead axles).	3		4
9	Identify various parts/ components of steering system and steering geometry and illustrate its working mechanism for given steering system.	4		4
10	Identify various parts/ components of hydraulic brake system and illustrate its working mechanism.	4	Any one	4
11	Identify various parts/ components of air/vacuum brake system and illustrate its working mechanism.	4		4
12	Identify various parts/ components of suspension system and illustrate its working mechanism for given suspension system.	5		4
13	Identify various parts/ components of different type of wheels & tyres and compare according to its uses.	5	Any one	2
14	Understanding tyre specifications and tyre size and identify suitable specification on wheels and tyres of a given vehicle.	5		2
	Total Hrs.			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.

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
	Identification of various parts/components. (Practical 1 to 4 & 7 to 13)	
1.	Name the part.	20
2.	Explain its location.	40
3.	Explain its main function.	40
Total		100

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
	Draw power flow diagram of parts/components. (Practical 5)	
1.	Use of appropriate instruments, lines, dimensioning & annotations.	40
2.	Accuracy of drawing	40
3.	Neatness of drawing	20
Total		100

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
	Study working of parts/components. (Practical 6)	
1.	Coverage of points in study work.	50
2.	Presentation of study work	50
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.

S. No.	Equipment Name with Broad Specifications	PrO. No.
1	Cut section /Demonstration model of powertrain assembly with chassis and frame assembly.	1,2

	The vehicle chassis should consist of a sectioned car. All the assemblies like Engine, Transmission line While running at lower speed by using an electric motor, the students can visualize the operation of important vehicle systems like an engine, gearbox, differential, power transfer to wheels	
2	<p>Cut section /Demonstration model of different types of clutch assembly</p> <p>This model is made out of original car clutch parts such as Flywheel, Pressure Plate, Clutch plates, etc. to demonstrate the working of clutch assembly. By operating the pedal provided the model can be demonstrated. The entire model is mounted on a sturdy iron frame.</p>	3
3	<p>Cut section /Demonstration model of different types of gear box units (sliding mesh, constant mesh, synchromesh gearboxes)</p> <p>This is made out of original car gearbox, suitably sectioned to show the details of gear mechanism of forward and reverse speeds. A crank lever is provided to demonstrate the mechanism. Complete unit is mounted on a sturdy iron frame.</p>	4,5
4	<p>Cut section /Demonstration model of overdrive and differential assembly.</p> <p>This should be made out of original differential unit assembly and it should demonstrate crown gear, pinion, and sun and star gears. A handle provided to observe slow action. The whole unit mounted on a strong steel stand.</p>	6
5	<p>Cut section /Demonstration Model of Propeller shaft and different universal joints.</p> <p>This should be made out of original propeller shaft and universal joint assembly to dismantle and assembly and the whole unit mounted on a strong steel stand.</p>	7
6	<p>Cut section /Demonstration model of front and rear axle assembly.</p> <p>This should be made out of original front axle assembly and it should demonstrate front and rear axle (live and Dead axle) and the axle unit mounted on a strong steel stand.</p>	8
7	<p>Cut section /Demonstration model of Steering linkages mechanism (Power steering)</p> <p>The cut section model should be carefully sectioned to show internal parts, The cut section steering gearbox used a genuine component from OEM.</p>	9
8	<p>Cut section /Demonstration Model of different types of Brake (Drum, Disc, hydraulics and Air brake)</p> <p>A Hydraulic Brake working model unit consisting of master cylinder with brake oil reservoir bottle can be operate by a pedal</p>	10,11

	for demonstration. Air brake working model unit consisting of Compressor with Air brake reservoir/Tank can be operate by a pedal for demonstration.	
9	Cut section /Demonstration Model of Suspension system (shocks absorber, coil spring, leaf spring, etc.) This should be made out of original Coil spring, Leaf spring, Rubber below and the cut section model should be carefully sectioned to show internal parts of Telescopic shock absorber assembly.	12
10	Cut section /Demonstration Model of different types of wheel and tyre assembly. Cut section model designed to enable students to study different types of tyres with different treads and the cutaway model should be carefully sectioned to show internal layer for training purposes, professionally painted with different colors to differentiate layer in a better way.	13,14

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 environmental 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.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
Unit I Introduction to Automobile Transmission System	1.a.Explain about power transmission system with its different layout. 1.b.Explain about chassis and frame with its classifications. 1.c.Differentiate between chassis and frame. 1.d.Describe chassis lubrication process.	1.1 Necessity of power transmission system of automobile vehicle. 1.2 Classification of power transmission layout based on: (a) Engine location. (b) Power output of axle. 1.3 Advantages and disadvantages of various power transmission system. 1.4 Introduction of Chassis. (a) Classification of chassis. (b) Bus/Truck chassis. (c) Ladder chassis (d) Frame less chassis. 1.5 Introduction of Frame. (a) Classification of Frame. -Conventional, semi integral and integral type, sub frame. (b) Various types of cross section used in frame channel, box and tubular section. (c) Load acting on frame. (d) Material for frame. 1.6 Differentiate chassis and frame.
Unit II Power transmission system (Clutch and Gearbox)	2.a.Describe requirement of clutch and gearbox. 2.b.Explain construction and functional details of various types of clutches and gear boxes. 2.c.Explain various clutch actuating mechanisms. 2.d.Describe various gear shifting mechanisms.	2.1.Necessity and requirement of clutch and gearbox. 2.2.Construction and functions of different types of clutches. - Single plate clutch, multiplate clutch and centrifugal clutch. 2.3.Construction detail of clutch plate and clutch lining materials. 2.4.Working of clutch actuating mechanism.

	<p>2.e.Explain construction and working of torque converter, overdrive and transfer case.</p> <p>2.f. Describe lubrication in gear box.</p>	<p>– Mechanical, vacuum and hydraulic.</p> <p>2.5.Principal, construction and working of fluid coupling.</p> <p>2.6.Construction and functions of sliding mesh, constant mesh, synchromesh gearbox.</p> <p>2.7.Working of gear shifting mechanism.</p> <p>2.8.Torque converter and overdrive-construction & working.</p> <p>2.9.Construction and working of transfer case.</p> <p>2.10. List the various types and grade, rating of lubricating oil used for gear box.</p>
<p>Unit III Driveline and axles (Front and Rear axles)</p>	<p>3.a.Explain construction and function of propeller shaft and its different types.</p> <p>3.b.Explain construction, function of universal joint and its different types.</p> <p>3.c.Explain construction, function of final drive and its different types.</p> <p>3.d.Explain construction, function of differential gear box.</p> <p>3.e.Describe different types of front & rear axle and its mounting methods.</p>	<p>3.1.Propeller shaft necessity (requirements), construction, function and its types.</p> <p>3.2.Universal Joint necessity, construction, function and its types.</p> <p>3.3.Final drive necessity, construction, function and its types.</p> <p>3.4.Differential necessity, construction and working.</p> <p>3.5.Types of front axle.</p> <p>3.6.Rear axle function and its types.</p> <p>3.7.Different types of axles mounting.</p>
<p>Unit IV Direction and stability control systems of vehicles (Steering and Braking systems)</p>	<p>4.a.Describe steering geometry and terminology.</p> <p>4.b.Explain various types of steering linkages and steering gears.</p> <p>4.c.Explain construction and working of different types of power steering systems.</p> <p>4.d.Describe requirement of braking system and its working principal.</p>	<p>4.1.Necessity of steering geometry.</p> <p>4.2.Describe Steering terminology: kingpin inclination, camber, caster, toe-in and toe-out.</p> <p>4.3.Types of steering linkages and steering gears.</p> <p>4.4.Effect of under & over steering, steering lock and turning circle radius.</p> <p>4.5.Construction and working of power steering systems.</p> <p>- Hydraulic, electrical & electronics controlled.</p>

	<p>4.e. Explain construction and working of different types of brakes and its mechanism.</p> <p>4.f. Explain characteristics of friction materials and discuss brake fluid properties.</p>	<p>4.6. Necessity and working principle of braking system.</p> <p>4.7. Types of brakes- its Construction and working, Braking Mechanism,</p> <p>4.8. Friction material and its characteristic</p> <p>4.9. Properties of brake fluid.</p>
<p>Unit V Comfort and stability systems of vehicles (Suspension system, Wheel and Tyres)</p>	<p>5.a Explain different types of springs used in suspension.</p> <p>5.b Explain construction and working of various types of suspension systems and shock absorber.</p> <p>5.c Describe various types and construction of wheel rims.</p> <p>5.d Explain construction and specification details of tyres.</p> <p>5.e Describe tyre rotation process and its need.</p>	<p>5.1 Necessity of suspension system in vehicle.</p> <p>5.2 Types of springs use in suspension system.</p> <p>5.3 Construction and functions of various types of suspension system.</p> <p>5.4 Construction and functions of shock absorber.</p> <p>5.5 Various types of wheel rims and its features.</p> <p>5.6 Concept of tyre aspect ratio</p> <p>5.7 Construction and application of wired spoke, disc and alloy wheels</p> <p>5.8 Constructional details of tube and tubeless tyres.</p> <p>5.9 Tyre rating and specification.</p> <p>5.10 Types of tyre tread pattern.</p> <p>5.11 Tyre rotation procedure.</p> <p>5.12 Tyre recycling, benefits and ways to dispose.</p>

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	Introduction to Automobile Transmission System	8	6	6	2	14
II	Power Transmission- (Clutch and Gearbox)	10	6	6	2	14
III	Driveline and Axles (Front and Rear Axles)	8	6	6	2	14
IV	Direction and stability control systems of vehicles (Steering and Braking systems)	8	6	6	2	14
V	Comfort and stability systems of vehicles (Suspension system, Wheel and Tyres)	8	6	6	2	14
	Total	42	30	30	10	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:

- Charts can be prepared.
- Small report on any topic given by concern faculty.
- 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 are 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:

Prepare charts on different automobile transmission system with construction and working.
Comparative study on Rim and tyres (Ply rating) used in vehicle. (Parameter– specification, price, etc. of 2-Wheeler, 3-Wheeler, LMV and HMV.)
Prepare Layout/Chart on construction details of different types of tyres.
Comparative study on Clutch and clutch mechanism used in vehicle. (Parameter– specification, price, etc.)

Comparative study on Gearbox and gear shifting mechanism used in vehicle. (Parameter–specification, price, etc.)
Draw various teeth patterns used in gear box and calculate the gear ratio of gear box.
Comparative study on Suspension system in different type’s vehicle (Parameter–specification of Car, Truck, Bus etc.)
Comparative study on Hydraulic and electrical assisted Power steering (Parameter–specification and its components.
Prepare Layout/Model of Hydraulics brake or Power assisted Brake(any one)

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Automobile Mechanics	William Crouse	Tata Mc-Graw Hill Publication ISBN-13:978-0-07-063435-0
2	Automotive Technology	James D Halderman	Pearson Education ISBN-10: 0-13-254261-7 ISBN-13: 978-0-13-254261-6
3	Automobile engineering	R B Gupta	Satya Prakashan, New Delhi ASIN: B077PT44VV ISBN: 9788176848589, 8176848581
4	Automobile engineering	K. M. Gupta	Umesh Publication ISBN: 818811422005
5	Automobile Engineering: Volume 1	Dr. Kirpal Singh	Standard Publishers ISBN-13: 978-8180141966
6	Automobile Engineering	Jain K K Asthana	McGraw Hill Education, New Delhi ISBN: 978-0-07-044529-1

14. SOFTWARE/LEARNING WEBSITES

- <https://www.howacarworks.com>
- <https://swayam.gov.in>
- <https://auto.howstuffworks.com>
- <https://nptel.ac.in>
- <https://tinyurl.com/mr29c4x8> for video link
- <https://tinyurl.com/4azv8h47> for web link

15. PO-COMPETENCY-CO MAPPING

Semester III	Automobile Transmission & Mechanism(4330202)						
	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 • Apply knowledge of construction and working of vehicle transmission and stability control system.	3	-	1	1	2	1	2
a) Identify various layout of Chassis-Frame and related power train system.	3	-	-	1	-	1	2
b) Explain the construction and working of power train system.	3	-	1	1	-	1	2
c) Describe need and working of driveline components and various axle assemblies.	3	-	-	1	-	1	2
d) Explain the construction and operation of direction and stability control system.	3	-	1	1	2	1	2
e) Explain construction and operation of Comfort and stability systems.	3	-	-	1	2	1	2

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**

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GTU BOS and Branch Co-ordinator Persons

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