

GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)**Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)****Semester -III**Course Title: **Automobile Design & Drafting**

(Course Code: 4330206)

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

1. RATIONALE:

Searching better option of any product/service is always main focus of any engineer. So, engineer should be aware of fundamental concepts of engineering design. Engineering design philosophy makes them well versed with the systematic and technically proven process of finding better options. For production of machine parts and components, it is required that specific shape and size of machine parts are determined from design criteria of specific component and then their drawings are prepared for production and display purpose. The students of Automobile engineering programme are mainly involved in activities like planning floor supervisor and quality check at manufacturing industries and vehicle service-related activities at automobile garage. At both the places, they have to interpret the drawings of components/ assemblies which are displayed at manufacturing plant or in workshop manuals. In this context, it is of utmost priority to prepare, read and interpret these drawings correctly to accomplish assigned task accurately. Development of sketching ability also strengthens effective engineering communication & presentation. Basic idea of design of machine elements and very basic procedure for designing major dimensions of some automotive components and basic of mechanical drafting is covered in this course.

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.

- **Design major dimensions of simple automobile component with appropriate material for given user defined boundary and loading conditions.**
- **Interpret basic engineering drawings.**

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) Appreciate various terminology and concepts of engineering design.
- b) Design simple machine element with given loading condition.
- c) Design simple major dimensions of automotive component form given data.
- d) Interpret basic engineering drawings for various activities either at manufacturing or service sector.
- e) Prepare component detail and assembly drawing from given data.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				Total Marks
L	T	P		Theory Marks		Practical Marks		
			C	CA	ESE	CA	ESE	
2	2	2	5	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. (1) SUGGESTED TUTORIAL 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.	Tutorial Outcomes (PrOs)	Unit No.	Approx. Hrs. required
1	Simple calculation on work, power, velocity, energy, moment, torque and their inter relation.	1	2
2	List design criteria for any two automotive components.	1	2
3	Calculate area, centroid and area moment of inertia of simple given cross section.	1	2
4	Design cross section of simple machine element subjected to pure axial load only.	2	3
5	Design cross section of simple machine element subjected to pure shear force only.	2	3
6	Design shaft under maximum torque.	2	2
7	Design axle under maximum bending moment.	2	2
8	Design head thickness of piston on given data	3	3
9	Design I-section/circular section of connecting rod from given data.	3	3
10	Design number of plates/face width/torque transmitted by clutch from given data.	3	2
11	Design mass and cross-sectional area of fly wheel from given data.	3	2
12	Draw and explain various notes in drawing.	4	2
	Total Hrs.		28

5. (2) 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	Draw and explain various Geometrical symbols in sketch book.	4	4
2	Draw and explain various machining symbols and drafting symbols like threading, dowels, pins, ribs, bearings, etc. in sketch book.	4	4
3	Draw development of surface of cylinder, cube, prism, and pyramid.	4	4
4	Draw detail drawing of piston from given data.	5	4
5	Draw assembly drawing of piston from given data.	5	4
6	Draw detail drawing of connecting rod from given data.	5	4
7	Draw assembly drawing of connecting rod from given data.	5	4
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. While designing exercises make sure that all COs are covered equally.*
- ii. *Care must be taken in assigning and assessing study report. Teacher can assign group of students a drawing that is available from industry/catalog/manuals and ask them to answer simple questions related to interpretation of drawing. Teacher can also ask them to find material required from the problem of surface development and bill of material (part list).*
- 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.*

Sr. No.	Sample Performance Indicators for the PrOs of tutorials (1 to12)	Weightage in %
1.	Explain concept/properties/terminology	30
2.	Understanding of quantities and their units	30
3.	Correct calculation/ list out critical consideration based on application.	40
Total		100

Sr. No.	Sample Performance Indicators for the PrOs (1 to 8)	Weightage in %
1.	Put correct idea of assigned work on drafting.	30
2.	Shows each detail carefully and appropriately in drawing.	30
3.	Draw the given problem with accuracy and neat work.	40
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 with Broad Specifications
1	Detachable assembly of piston, connecting rod, clutch, Flywheel, crankshaft, propeller shaft and axle.
2	Set of various industrial updated drawings being used by industries.
3	Large size drawing equipment's and instruments for class room teaching-. Half imperial size drawing board. T-square or drafter (Drafting Machine). Set squares (45 ⁰ ,30 ⁰ and 60 ⁰) Protector. Drawing instrument box (containing compasses and divider and circle master).

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) Practice & follow valid Design Standards to assure quality work in design of automobile components.
- b) Follow ethical practices as Team leader and enable team members to do so at work.
- c) Design automobile components considering human ergonomics.
- d) **Student should be able to identify ecofriendly or recycled material prior to selection for automobile applications. (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 supporting 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 engineering design.	1a List various factors to be considered for design process. 1b Compare various materials used to make automotive components. 1c Explain various loads/forces acting on a component, stresses generated and factor of safety. 1d Appreciate basic concepts of engineering design. 1e Calculate area, centroid and area moment of inertia of simple section.	1.1 Design and its types, General consideration and factors influencing the design of machine elements and general design process. 1.2 Various materials used in manufacturing of automotive components. (Which and why) 1.3 Basic definitions and SI units of Mass, weight, force/load, stress, pressure, torque, work, energy, moment, couple, strain, young modulus, modulus of rigidity, Bulk modulus, inertia, power, area moment of inertia and mass moment of inertia 1.4 Types of loads, types of stresses. 1.5 Concept of stress concentrate and factor of safety. 1.6 Standardization and interchangeability. 1.7 Column and Strut, different end conditions, Rankin's and Euler's Formulae. 1.8 Limits, fits and tolerances. 1.9 Design consideration for automotive components (piston, connecting rod, clutch, valve, crankshaft, gears, shaft and axle)
Unit II Design of simple machine components.	2a Design cross section of simple machine element subjected to pure axial load only.	2.1 Simple machine element subjected to pure axial load only.

	<p>2b Design cross section of simple machine element subjected to pure shear force only.</p> <p>2c Design shaft under maximum torque.</p> <p>2d Design axle under maximum bending moment.</p>	<p>2.2 Simple machine element subjected to pure shear load only.</p> <p>2.3 Design of shaft used for power transmission only.</p> <p>2.4 Design axle used to take direct load only.</p>
Unit III Design of automotive components.	<p>3a Calculate head thickness of piston</p> <p>3b Calculate I-section/ circular section of connecting rod.</p> <p>3c Calculate face width of friction lining material/torque transmitting capacity of given clutch.</p> <p>3d Calculate mass and cross-sectional area of flywheel.</p>	<p>3.1 Piston nomenclature and Design of IC-engine piston head thickness.</p> <p>3.2 Design of I-section/circular section of connecting rod.</p> <p>3.3 Understand uniform wear and pressure condition for designing clutch. Design face width and no. of clutch lining required for given torque and other boundary condition.</p> <p>3.4 Turning moment diagram of flywheel, fluctuation of speed and energy, finding mass and cross-sectional area of flywheel.</p>
Unit IV Basics of drafting.	<p>4a Explain various types of drawing (used for manufacturing, catalog, workshop manuals) of automotive component.</p> <p>4b Explain importance and difference of detail and assembly drawing.</p> <p>4c Interpret various drafting symbols and notes in a drawing.</p> <p>4d Understand concept of surface development and draw surface development of simple shapes.</p>	<p>4.1 Various types of automotive component drawing used at manufacturing unit, workshop manuals and catalog of car. (Just make them understand how drawings differs considering the purpose for which they are prepared)</p> <p>4.2 Importance and differences of detail drawing and assembly drawing.</p> <p>4.3 Machining symbol and its interpretation.</p> <p>4.4 Geometrical symbols and its interpretation.</p> <p>4.5 Other drafting symbols like threading, dowels, pins, ribs, bearings, etc.</p> <p>4.6 Notes in drawing like heat treatment conditions, surface conditions, assembly notes, etc. (All symbols as per BIS).</p>

		4.7 Importance of development of surfaces. Drawing of development of surfaces of simple shapes like cylinder, cone, pyramid, prism.
Unit V Drafting of automotive components	5a Draw assembly and detail drawing of IC-engine piston. 5b Draw assembly and detail drawing of IC-engine connecting rod	5.1 Detail drawing of piston and connecting rod with bill of material. 5.2 Assembly drawing of piston and connecting rod.

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.

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 engineering design.	08	4	6	4	14
II	Design of simple machine components.	06	2	8	4	14
III	Design of automotive components.	08	4	6	4	14
IV	Basics of drafting.	04	10	2	2	14
V	Drafting of automotive components.	02	4	4	6	14
	Total	28	24	26	20	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:

- Industrial drawings of small components should be given for making their (students) own remarks/ interpretation.

- b. Calculation based on development of surface (Application type e.g. Material required to form given three dimensional surface.
- c. Comparison of dimensions achieved by using different material for same application. (Here teacher can use other comparison factor like material required/ space required, cost etc.)
- d. Identify the mode of failure for given automobile component and prepare a note on basic design requirements for particular component.
- e. Prepare chart of materials currently used for automotive components.
- f. Prepare charts representing cross-section areas of various 3D shapes.
- g. Prepare charts related to area moment of inertia for calculation of centroid of various shapes.

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**
- g) Theory, Tutorial & Practical aspects is covered in best way which every student must learn before undergoing actual Design of automobile component.

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 chart of materials currently used for automotive components (on which and why basis)
Prepare charts related to area, centroid and moment of inertia of common shapes.
Prepare chart representing geometrical, machining and other drafting symbols.
Prepare a list where surface development is useful with explanation.
Prepare booklet which covers all the formulae that requires to be recalled for calculation of design problems.
Demonstrate Part/Assembly drawing including dimensioning, geometric tolerance, surface finish, threads, welds, bearing, etc.
Perform case study of design of any automobile component.

13. SUGGESTED LEARNING RESOURCES:

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	A Text book of Machine Design	R S Khurmi J K Gupta	S. Chand & Co. Ltd, New Delhi(2022); ISBN: 978-8121925372
2	Design of Machine Elements	V. B. Bhandari	McGraw Hill Education India Pvt. Ltd., Noida (2017) ISBN: 978-9339221126
3	Machine Design	P. C. Sharma D. K. Aggarwal	S. K. Kataria & Sons, New Delhi(2013) ISBN: 978-9350142813
4	Machine Design	R. K. Jain	Khanna Publishers, Delhi (1988) ISBN:978-81-7409-286-1
5	Automobile Design Problems	K. M. Aggarwal	Satya Prakashan, New Delhi(1994) ISBN: 8176842079, 9788176842075
6	A Text book of Engineering Mechanics	R S Khurmi N. Khurmi	S. Chand & Co. Ltd, New Delhi(2019); ISBN: 978-93-5283-396-2
7	Machine Drawing	P. S. Gill	S. K. Kataria & Sons, New Delhi(2013) ISBN: 978-9350144169
8	Machine Drawing	P J Shah	S. Chand & Co. Ltd, New Delhi(1988); ISBN: 978-8121929660
9	Machine Drawing	N. D. Bhatt	Charotar Publishing House Pvt. Ltd. (2014) ISBN: 978-9385039232

14. SOFTWARE/LEARNING WEBSITES

- <https://www.howacarworks.com>
- <https://swayam.gov.in>
- <https://auto.howstuffworks.com>
- <https://nptel.ac.in>
- <https://tinyurl.com/mrydd483> for video link
- <https://tinyurl.com/msrp5yv2> for web link

15. PO-COMPETENCY-CO MAPPING

Semester III	Automobile Design & Drafting (4330206)						
	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 <ul style="list-style-type: none"> Design major dimensions of simple automobile component with appropriate material for given user defined boundary and loading conditions. Interpret basic engineering drawings. 	3	2	2	2	1	1	3
a) Appreciate various terminology and concepts of engineering design.	3	2	2	-	1	1	3
b) Design simple machine element with given loading condition.	3	2	2	-	1	1	3
c) Design simple major dimensions of Automotive component from given data.	3	2	2	-	1	1	3
d) Interpret basic engineering drawings for various activities either at manufacturing or service sector.	3	2	-	2	-	1	3
e) Prepare component detail and assembly drawing from given data.	3	-	-	2	-	-	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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