GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2022 (COGC-2022)
IV – Semester

Course Title: Computer Aided Drafting-II
(Course Code: 4346503)

Diploma programmer in which this course is offered	Category	Semester in which offered
Mechanical Engineering(CAD/CAM)	Program Core	Fourth

1. RATIONALE

Mechanical engineers are responsible for designing and manufacturing a wide range of products, from small components to complex machines. In order to do this effectively, they need to be able to create and interpret 3D models of engineering parts and assemblies.

Parametric solid modeling software is a powerful tool that allows engineers to create and modify 3D models quickly and easily. Parametric software uses constraints to link geometric features together, so that when one feature is changed, the other features are updated automatically. This makes it easy to make changes to designs without having to start from scratch.

In addition to its power and flexibility, parametric solid modeling software is also widely used in industry. This means that students who learn to use this software will be well-prepared for jobs in the mechanical engineering field.

The course will teach students the fundamentals of parametric solid modeling using any popular parametric solid modeling software. Students will learn how to create and modify 3D models of engineering parts and assemblies, create engineering drawings from parametric models, and perform simple animations of assembly and analysis of parts for mechanical and thermal stress.

2. COMPETENCY

The course content should be taught and implemented with the aim to develop different types of skills so that students are able to acquire following competency:

1. Proficiency in Parametric Modeling Software
2. Engineering Drawing and Analysis Skills

3. COURSE OUTCOMES

The practical should be carried out in such a manner that students are able to acquire different learning outcomes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

1. Apply parametric modeling techniques to create 3D mechanical components using industry-standard software.
2. Apply parametric modeling techniques to create simple assemblies using industry-standard software.
3. Generate precise engineering drawings and comprehensive documentation from parametric models.
4. Analyze parametric models of mechanical assembly to ensure movement integrity through animation simulations.

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	
0	0	4	2	00	00	25*	25	50

(*): For this practical only course, 25 marks under the practical CA have two components i.e. the assessment of micro-project, which will be done out of 10 marks and the remaining 15 marks are for the assessment of practical. This is designed to facilitate attainment of COs holistically, as there is no theory ESE.

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

5. SUGGESTED PRACTICAL EXERCISES

Following practical outcomes (PrOs) are the subcomponents of the Course Outcomes (COs). All PrOs are compulsory, as they are crucial for that particular CO at the 'Precision Level' of Dave's Taxonomy related to 'Psychomotor Domain'.

Faculty can utilize any parametric 3D modeling software accessible at their institution to supplement the teaching and learning process for this course. However, pursuant to the Memorandum of Understanding (MoU) between Autodesk and AICTE, parametric software like Fusion 360 and Inventor can be made available to faculty members and students, granting them access to the design software to enhance their learning experience.

Sr. No.	Practical Outcomes (PrOs)	Approx. Hrs. Required	CO
1	Create and modify 3D models of mechanical components using parametric modeling software. Select Mechanical Components: Students will select four mechanical components to model. The components should be complex enough to challenge students, but not so complex that they are impossible to model and draw. Create 3D Models: Using the parametric modeling software, students will create 3D models of the selected mechanical components. The models should be accurate and detailed.	12	CO1

Sr. No.	Practical Outcomes (PrOs)	Approx. Hrs. Required	CO
	Students will submit the completed models in relevant file format. Modify 3D Models: Students will modify the 3D models to incorporate design changes. The modifications should be significant enough to demonstrate the power of parametric modeling.		
2	Create and modify 3D models of mechanical assemblies using parametric modeling software. Select Mechanical assembly: A group of 4-5 Students will select a mechanical assembly having 6 to 10 parts to model. The assembly should be complex enough to challenge students, but not so complex that they are impossible to model. Create 3D assembly: Using the parametric modeling software, a group of students will create 3D models of the selected mechanical assembly. The model should be accurate and detailed, and should include all dimensions and tolerances. Students will submit the completed assembly in relevant file format. Modify 3D Models: Students will modify the 3D models to incorporate design changes. The modifications should be significant enough to demonstrate the power of parametric modeling.	12	CO2
3	Generate engineering drawings and documentation from parametric models. Using parametric software's drawing generation tools students will create orthographic production drawings of the 3D models prepared in practical number 1 and 2. The drawings should include all dimensions, tolerances, notes, a title block, and other necessary annotations. Students will submit the completed drawings in PDF format.	08	CO3
4	Employ simulation tools in parametric software to analyze the kinematic motion of a mechanical assembly. Use Simulation tools of your parametric software to analyze the kinematic motion of an assembly designed in practical number two. The simulation should show how the various parts interact with each other. Students will submit the completed task in relevant file format.	08	CO4
5	**Mini Project** The mini project should aim to develop and showcase the students' proficiency in parametric modeling software and engineering drawing and analysis skills. The project should involve creating and analyzing 3D models of mechanical	16	ALL

Sr. No.	Practical Outcomes (PrOs)	Approx. Hrs. Required	CO
	components or assemblies. **Project Selection Criteria**: ● Relevance to Course Objectives: The project should directly address the course objectives of developing proficiency in parametric modeling software and engineering drawing and analysis skills. ● Complexity and Challenge: The project should be of a suitable complexity level that challenges students to apply their knowledge and skills effectively without being overwhelming. ● Practical Application: The project should have real-world relevance and demonstrate the practical application of parametric modeling software and engineering drawing and analysis skills. ● Creativity and Innovation: The project should encourage creativity and innovation in design solutions, allowing students to explore their problem-solving abilities. ● Individual or Group Work: The project to be undertaken as a group project, fostering collaboration and teamwork skills.		
		56	

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.*

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	Weightage in %
1.	Lab Records and regularity	15
2.	Question answer / understanding steps of exercise	15
3.	Execution of exercise	30
4.	Printout/Result	10
5.	Viva voice	30
Total		**100**

6. MAJOREQUIPMENT/ INSTRUMENTS REQUIRED

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

Sr. No.	Equipment Name with Broad Specifications	PrO. No.
1.	Computer system with latest configuration.	All
2.	Laser printer - plotter A2 size.	All
3.	Related software. (Any parametric modeling software like Pro-E, SolidEdge, SolidWorks; Autodesk Inventor, Fusion-360). (Refer this MoU for free usage of parametric software at your institute)	All

7. AFFECTIVE DOMAIN OUTCOMES

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

a) Work as a leader/a team member.
b) Follow safety practices while using electrical and electronics equipment.
c) Maintain tools and equipment.
d) Realize the importance of E-waste management. (Environment related).

The ADOs are best developed through the laboratory/field based exercises. 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 UOs could be included by the course teacher to focus on attainment of COs and competency.

Unit	Unit Outcomes (UOs) (3 to 5 UOs at different levels)	Topics and Sub-topics
Unit-I Introduction to Parametric Solid Modeling	• Define parametric design and explain its benefits. • Apply the key concepts of parametric design, such as features, constraints, and parameters.	• Understanding parametric design principles. • Introduction to 3D modeling terminology and concepts. • Exploring the history and development of parametric

Unit	Unit Outcomes (UOs) (3 to 5 UOs at different levels)	Topics and Sub-topics
	● Create and edit basic 3D models using parametric software. ● Navigate the user interface of a popular parametric modeling software package (e.g., SolidWorks, Autodesk Inventor, or PTC Creo). ● Configure settings and preferences for efficient modeling.	modeling. ● Differentiating between parametric and non-parametric modeling. ● Familiarization with any one or more popular parametric modeling software (e.g., SolidWorks, Autodesk Inventor, PTC Creo etc). ● Navigating the software's user interface. ● Configuring settings and preferences for efficient modeling.
Unit-II Creating and Modifying 3D Models of Engineering Parts	● Create and modify 3D models of engineering parts using parametric features, constraints, and parameters. ● Apply advanced parametric modeling techniques to create complex engineering parts	● Overview of essential tools and commands for creating parametric solid models ● Building and editing 3D geometry using parametric techniques. ● Sketching and constraining 2D profiles for 3D features. ● Applying geometric and dimensional constraints. ● Working with extrusions, revolve, sweeps, and other modeling operations. ● Exploring advanced modeling techniques like patterns, shells, and loft.
Unit-III Creating and Modifying 3D Models of Engineering Assemblies	● Create and modify 3D models of engineering assemblies using parametric software. ● Apply parametric assembly techniques to create assemblies with multiple parts. ● Use parametric mates to constrain the movement of parts in an assembly.	● Managing Assembly Files and Folders. ● Configuring Assembly Settings for Efficient Modeling ● Exploring Parametric Assembly Techniques. ● Understanding Parametric Mates, constraints and relations.
Unit-IV Creating and Modifying Engineering Drawings from Parametric Models.	● Create assembly drawings, detail drawings, and section drawings. ● Dimension and annotate engineering drawings according to engineering standards. ● Update engineering drawings automatically when the parametric model is modified.	● Creating assembly drawings using parametric software. ● Creating detail drawings using parametric software ● Creating section drawings using parametric software. ● Dimensioning and annotating engineering drawings.

Unit	Unit Outcomes (UOs) (3 to 5 UOs at different levels)	Topics and Sub-topics
	● Generate engineering drawings in multiple formats, such as PDF, DWG, and DXF.	● Updating engineering drawings automatically ● Generating engineering drawings in multiple formats.
Unit-V Simple Animations of Engineering Assemblies.	● Create simple animations of engineering assemblies using parametric software to simulate their movement and performance.	● Using parametric software to create simple animations of engineering assemblies ● Animating the movement of parts in an assembly ● Analyzing the performance of an assembly using animation

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
Not applicable						

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

9. SUGGESTED STUDENT ACTIVITIES

Other than the 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 perform following activities in groups and prepare reports of about 5 pages for each activity. They should also collect/record physical evidences for their (student's) portfolio which may be useful for their placement interviews:

a) Undertake micro-projects in team/individually.
b) Students are encouraged to register themselves in various MOOCs such as: Swayam, edx, Coursera, Udemy etc. to further enhance their learning.
c) Select at least four mechanical components and get them approved by the teacher. Measure and model these parts and present them in a report with dimensions. (For Ex. No 01).
d) Select at least one simple mechanical assembly in a group of 5-6 students, each made up of minimum 6-10 components. Get them approved by the teacher. Prepare the solid model of the assembly and present it in a report with dimensions. (For Ex.No.02).
e) Bring Actual assembly from workshop/industry, measure dimensions, sketch it and make 3D production drawing for the same. (For Ex.No. 03)
f) Prepare Charts that classify recycling processes for electronic waste and plastics.

10. 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/subtopics.

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

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

Guide students on addressing the issues on environment and sustainability using the knowledge of this course.

c) Guide students for keeping the drawings in digital form and reduce use of paper.

11. 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-projects are group-based (group of 3 to 5).

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. The duration of the micro project should be about **14-16** ***(fourteen to sixteen) student engagement hours*** during the course. The students 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:

- Design and model a custom part for a specific industry, such as a manufacturing part, a medical device, or a consumer product.
- Create a parametric model of a real-world object / assembly i.e., piston crankshaft, Cam and follower, knuckle joint, cotter joint, gear train, tail stock etc.
- Use parametric solid modeling software to design and simulate a manufacturing process, such as injection molding or CNC machining.
- Research and compare different parametric solid modeling software packages.
- Create a video tutorial on parametric solid modeling.
- Develop a web community or web application that allows users to design and share parametric models.
- Build a physical prototype of a parametric model using a 3D printer or CNC machine.
- Use parametric solid modeling software to design and animate various mechanisms used in study of theory of machine.
- Deliver expert lectures on parametric solid modeling for other students.

12. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
1	Engineering Design with SolidWorks	David C. Planchard	SDC Publications ISBN: 9781630574680
2	Mastering SolidWorks	Matt Lombard	Publisher: John Wiley & Sons Inc ISBN: 9781119300588
3	Creo Parametric 9.0	Cadartifex Sandeep	Publisher: Cadartifex ISBN: 9789394074026
4	Autodesk Inventor	James D. Bethune	Publisher: Pearson Education ISBN: 9780131190733
5	Parametric Modeling with Fusion 360	Randy Shih	SDC Publications ISBN: 9781630570552

13. SOFTWARE/LEARNING WEBSITES

Autodesk Inventor

- Autodesk Inventor Learning Center: https://www.youtube.com/watch?v=iCnVZrzz1VI
- Autodesk Inventor Documentation: https://www.autodesk.com/support/technical/product/inventor
- Autodesk Inventor Tutorials: https://www.youtube.com/watch?v=KKbwf2a53bA

Dassault Systèmes SolidWorks

- SolidWorks Tutorials: https://www.youtube.com/watch?v=E69EqFY2qMc
- SolidWorks Tutorials: https://www.youtube.com/watch?v=CiBwrjUeB8U
- SolidWorks Help Center: https://www.solidworks.com/support/home

PTC Creo Parametric

- PTC Learning Community: https://community.ptc.com/
- PTC Creo Parametric Tutorials: https://support.ptc.com/help/creo/creo_pma/r10.0/usascii/tutorials_pma/pma_tutorials.html
- PTC Creo Parametric Documentation: https://support.ptc.com/images/cs/articles/2018/05/1525425932uNM3/tkuse.pdf

Fusion 360

- Autodesk Fusion 360 Learning Center: https://help.autodesk.com/view/fusion360/ENU/courses/
- Fusion 360 Tutorials: https://www.youtube.com/watch?v=qvrHuaHhqHI
- Fusion 360 Help Center: https://help.autodesk.com/view/fusion360/ENU

14. PO-COMPETENCY-CO MAPPING

Semester IV	Computer Aided Drafting-II (Course Code: 4346503)						
	POs						
Competency & Course Outcomes	**PO 1 Basic & Discipline specific knowledge**	**PO 2 Problem Analysis**	**PO 3 Design/ develop-ment of solutions**	**PO 4 Engineering Tools, Experimen-tation & Testing**	**PO 5 Engineering practices for society, sustainability & environment**	**PO 6 Project Managemen t**	**PO 7 Life-long learning**
Competency **1**. Proficiency in Parametric Modeling Software	3	2	3	3	2	2	2
2. Engineering Drawing and Analysis Skills	2	2	2	2	2	2	3
CO1 - Apply parametric modeling techniques to create 3D mechanical components using industry-standard software.	3	2	2	3			2
CO2 - Apply parametric modeling techniques to create simple assemblies using industry-standard software.	3	2	2	3		2	2
CO3 - Generate precise engineering drawings and comprehensive documentation from parametric models.	3		2	3	2	3	2
CO4 - Analyze parametric models of mechanical assembly to ensure movement integrity through animation simulations.	2	3		2			

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

15. COURSE CURRICULUM DEVELOPMENT COMMITTEE

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