GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Minor/Hons. Program
Level: UG
Branch: Minor/Hons. 3 D Robotics
Subject Code: BE050AN021
Subject Name: Solid Modelling

w. e. f. Academic Year:	2026-27
Semester:	5
Category of the Course:	Core Courses

Prerequisite:	None
Rationale:	3D models means solid model is usually originated on the computer by engineer using some kind of solid modeling software. Solid modeling is a process of developing a mathematical representation of any 3D object. Solid models are often animated for some uses. Today 3D models are used in wide variety of engineering fields for visualization and analysis. 3D computer graphics are widely used for product design, assembly design etc. A Professional Engineer and students should have the knowledge of solid modeling software to visualize the machine components & assembly like cars, machine tools and earth movers etc,. Solid modeling is the expertise is the current requirement of the Industry.

Course Outcomes:

Sr. No.	CO statement	Marks% weightage
CO-1	Make use of the engineering modelling software.	20
CO-2	Interpret 2-D and 3-D Engineering modelling.	30
CO-3	Dissect assembly modelling.	30
CO-4	Analyze 3-D printing data.	20

Teaching and Examination Scheme:

Teaching / Learning Scheme (in Hours per semester)					Total Credits = TH/30	Assessment Pattern and Marks					Total Marks
						Theory		Tutorial / Practical			
L	T	P	PBL*	TH		ESE (E)	PA (M)	PA (I)	PBL (I)	ESE (V)	
45	0	60	45	150	5	70	0	0	50	30	150

**** Problem Based Learning (PBL) aims to accommodate learning beyond syllabus as per clause 9.4 of NBA manual.***

Where L = Lecture, T= Tutorial, P= Practical, TW/SL = Term-Work / Self-Learning, TH = Total Hours, PA = Progressive Assessment, ESE = End-Semester Examination

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Content:

Sr. No.	Content	Total Hrs
1	**Working in 2 D environment:** Working in sketcher mode with entities such as line, profile, circle, arc, rectangle, and their sub-options. Application of constraints including dimensioning and geometrical constraints for accurate and robust 2D sketches. Introduction to best practices in sketching for downstream 3D modeling.	7
2	**Working in 3D environment:** Intersection of solids and design of solids using solid entities. Boolean operations, Boundary Representation (B-rep), and Constructive Solid Geometry (CSG) approaches. Advanced modeling methods including feature-based design, parametric relationships, and surface-to-solid conversions. Creation of complex 3D solid models suitable for analysis, prototyping, and 3D printing.	10
3	**Introduction to Solid Modeling:** Introduction, applications, benefits, and need for solid modeling in modern engineering, product design, and manufacturing. Overview of hardware requirements and commonly used software packages for solid modeling. Understanding software features such as parametric modeling, history-based modeling, and direct modeling to enhance design efficiency.	7
4	**Assembly:** Understanding top-down and bottom-up assembly approaches. Placement constraints and preparation of assembly drawings using assembly features. Assembly of a minimum of 4–5 engineering components, including mating, alignment, and motion considerations. Creation of exploded views and exploded assemblies for documentation and visualization purposes.	8
5	**3D Printing Data Formats:** Overview of CAD data exchange formats and tessellated models. STL format, common STL file problems, STL file manipulation, slicing, and repair algorithms. Study of AMF, 3MF, XML, metadata, PLY, and STEP formats for additive manufacturing applications. Emphasis on selecting appropriate data formats for different printing technologies.	8
6	**3D Printing Data Processing:** Part orientation and support structure generation for optimal printing quality and reduced material use. Model slicing and contour data organization, including direct and adaptive slicing techniques. Hatching strategies, tool path generation, and optimization for different AM processes to improve accuracy, surface finish, and build time.	5
	TOTAL	**45**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
25	25	25	25	--	---

R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Reference Books:

1. David F. Rogers, J. A. Adams, "Mathematical Elements for Computer Graphics", TMH, 2008.
2. Anupam Saxena, Birendra Sahay, "Computer Aided Engineering Design", Springer, 2005.
3. Michael E. Mortenson, "Geometric Modeling", Wiley, NY, 1997.
4. Ian Stroud, Hildegarde Nagy," Solid Modelling and CAD Systems", Springer, 2011

List of experiments:

1. Introduction to Solid Modeling Packages
2. Working with sketch mode of Solid modeling Package
3. Working with modeling tools.
4. Working with Surface modelling.
5. Working with advanced modeling tools.
6. Assembly modeling using appropriate assembly constrains.
7. Working with CAD Data Exchange formats: IGES, ACIS, DXF STL, AMF
8. Identification of STL file problems using MAGICS (or any open source) Software
9. Part orientation, support and Tool path generation in CURA (or any open source) Software.
10. Case study on 3D Modelling and data processing for 3D printing

List of Open Source Software/learning website:

https://onlinecourses.nptel.ac.in

List of suggested activities for Problem Based Learning:

Sr. No.	Name of the activity	No. of hours	Evaluation Criteria
1	Industry/Research laboratory visit	Visit = 5hrs., Report preparation = 5hrs. Total = 10hrs.	Based on report submitted. Report should contain observations and calculations based on industry/ lab data.
2	Technical Video based learning related to the subject	Duration of video = 5hrs. Report preparation = 5hrs. Total = 10hrs.	Report/presentation based on the video learning outcomes.
3	Problem solving/Coding using C, C++, MATLAB, Python, SCILAB modeling and Analysis software or any other software	5 small coding-based assignment of 2hrs. each. Total = 10hrs.	Based on the coding solution submitted.
4	Self-learning online course	Minimum duration of the course should be 10hrs.	Examination based assessment at the end of course. Based on the certificate produced.
5	Technical paper reading and summarization of research papers	5 research papers = 20 hrs.	Summarize research paper and evaluation critical parameters based on relevant subject.
6	Poster/chart/power point preparation on technical topics	Duration = 6 hrs.	Based on poster/chart preparation and presentation skills.
7	Working/non-working model on technical topics	Working = 12 hrs. Non-working = 8 hrs.	Based on inter department/external evaluation.
8	Industrial exposure for 2-3 days to observe and provide tentative solutions on society/environment/health/sustainability/any other issue	Duration = 15 hrs. for industrial exposure. Problem identification and tentative solution = 10 hrs. Total = 20 hrs.	Based on evaluation of critical problems and solutions.
9	Group Discussion on emerging/trending technical topics based on subject	Duration = Min. 1 hr per subject. Max. 3 hrs. per subject.	Based on performance in group discussion, technical depth, knowledge etc.

10	Real world case studies-based learning	Duration of data collection/study = 5hrs. Report preparation = 5hrs. Total = 10hrs.	Based on in-depth study, technical depth, data collected, fact finding, etc.
11	Application/Software development	Duration = 10 hrs.	Depending on the complexity of the Application/Software.
12	Research paper publication	Duration = 10 hrs.	Based on submission of proof of publication.
13	Upgradation/Reverse engineering studies of existing equipment of the laboratory	Duration 10 hrs.	Based on the performance of the equipment.
14	Expert lecture/session	Duration 3 hrs. For attending the lecture/session - 2 hrs. and for report writing 1 hr.	Based on the proof of attendance and report submitted.
15	Annotated Video Explanation of Concept/Problem	10h (Preparation + Recording + Submission)	Based on accuracy of explanation, clarity, and presentation style.
16	Patent Search and Innovation Gap Identification	10h (Search + Report)	Based on number of relevant patents analyzed and identification of innovation scope.

Note:
1. All the suggested activity should be related to the subject.
2. The number of hours are suggestive. Faculty can sub-divide the number of hours based on the activity. However, total number of hours is fixed.
3. Rubrics for the evaluation can be prepared by the faculty.
4. Subject teacher can add the relevant activities other than those listed above, with the consent of head of the department and DQAC.

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