

# New approach to teaching engineering drawing to engineering students

**Sharad Marathe | Rio D'Souza**

Universal Technical Systems Inc. | St. Joseph Engineering College

**Conventional versus  
novel approach**

# Teaching engineering drawing / graphics

## The conventional approach

- Starting with 2D projections and asking students to visualize parts in 3D. Many students find this difficult.
- Too much focus is on theory and not on real world applications.
- Students from circuit branches (Computer Science, Electronics & Communication, Electrical) do not relate to the content.

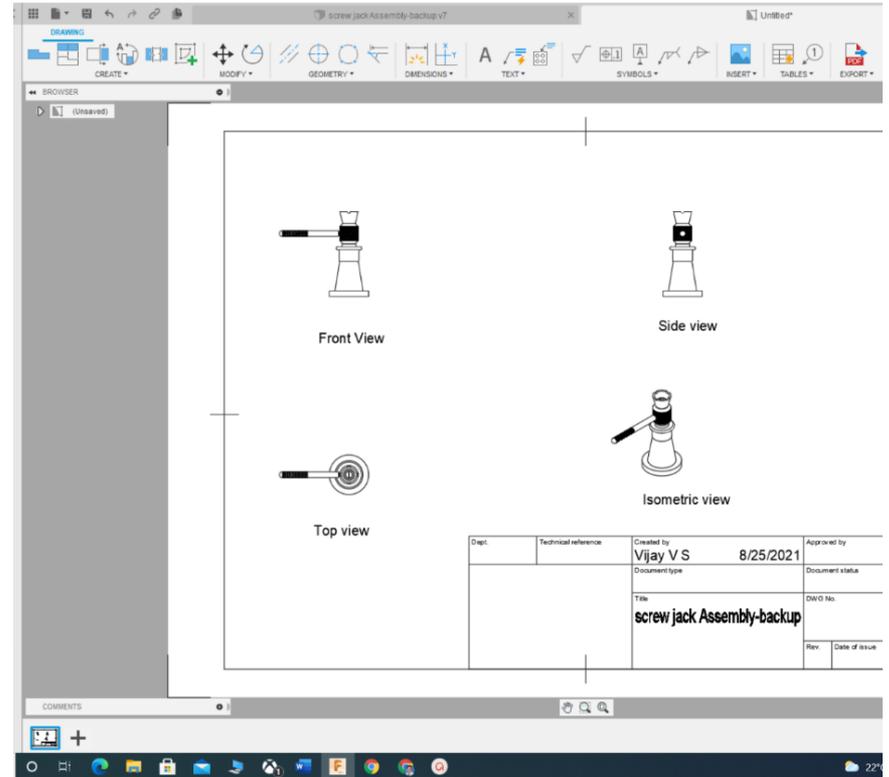
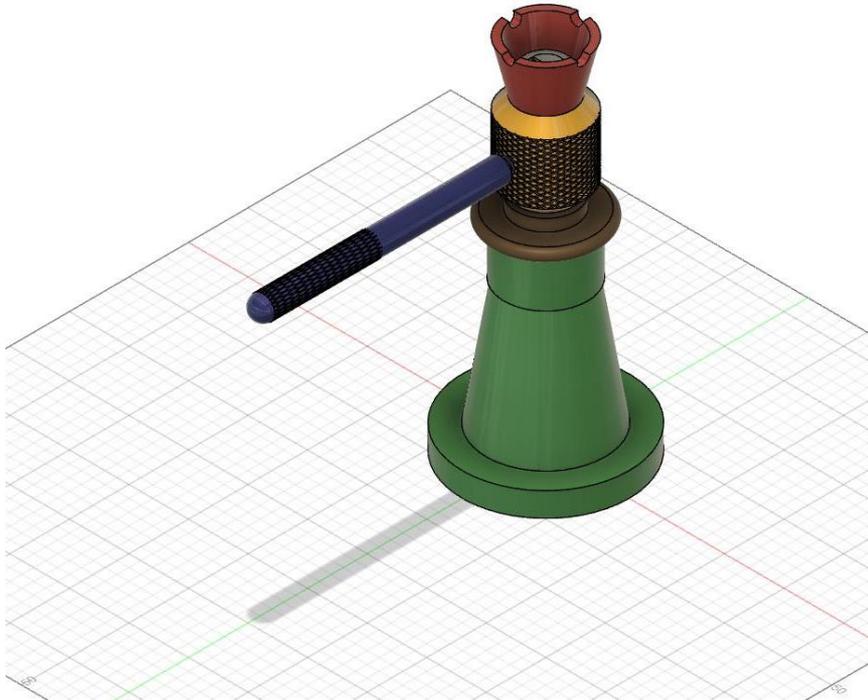
# Teaching engineering drawing / graphics

The new method

- Start with 3D modeling using Autodesk® Fusion 360®.
- 2D projections are automatically generated. This makes it easy for students to grasp the concepts.
- The concepts are taught using multidisciplinary case studies.
- A problem-based learning pedagogy is adopted.
- Hands-on experiential learning from day one.

# Example - screw jack

3D model of screw jack in Fusion 360 and 2D projections / isometric view obtained



# Novelty

- **Application:** New method for use by faculty and students. AICTE can use it in faculty development programs for engineering and polytechnic faculty.
- **3D modeling:** Uses 3D modeling to teach all concepts right at the outset.
- **Industrial standards:** Students are exposed to latest technology that industry is using in product development.
- **Technology:** Harnesses the power of multimedia technology to bring diversity in pedagogies, such as e-learning content, videos, animations, etc.
- **Pedagogy:** The new approach uses the principles of ‘outcome-based education’ and ‘problem-based learning’.

# **Learning management system**

# UTS Learning Center

The learning content developed by the team is integrated into UTS Learning Center which is a Learning Management System (LMS). This LMS can be used for deploying eBooks and other online learning content for use by in a self-paced learning mode.

The LMS is developed by Universal Technical Systems, Inc. (UTS). UTS is part of a family of companies, including Universal Technical Systems, in US, UK, and India.

Some other engineering software from UTS are TK Solver and Galaxy.



# Screenshot of UTS Learning Center

The screenshot displays the UTS Learning Center interface. At the top, a dark blue header contains the UTS logo on the left and the user name 'Dr Binu K G' with a profile icon on the right. Below the header, a breadcrumb trail reads 'Home > My courses > eBook on Engineering Graphics'. On the left side, a vertical navigation menu is titled 'NAVIGATION' and lists various site sections, with 'eBook on Engineering Graphics' expanded to show sub-items like 'Participants', 'Badges', 'Competencies', 'Grades', 'Announcements', and a list of modules. Below the navigation menu is a search bar with a 'Go' button and a link to 'Advanced search'. The main content area features an 'Announcements' icon and a section for 'Module 1 - Introduction to 3D Modelling'. This section contains a list of topics, each with a document icon and a checkbox on the right. The topics include 'Topic level outcomes', 'Contents', seven numbered items (some with video icons), and three assessment items (some with checkmark icons). The bottom of the page shows the beginning of a section for 'Module 2 - Introduction to Engineering Drawing'.

UTS

Dr Binu K G

Home > My courses > eBook on Engineering Graphics

NAVIGATION

- Home
- Dashboard
- Site pages
- My courses
  - eBook on Engineering Graphics**
    - Participants
    - Badges
    - Competencies
    - Grades
    - Announcements
    - Module 1 - Introduction to 3D Modelling
    - Module 2 - Introduction to Engineering Drawing
    - Module 3 - Introduction to Engineering Drawing
    - Module 4 - Introduction to Engineering Drawing
    - Module 5 - Introduction to Engineering Drawing
  - Courses

SEARCH

Advanced search ?

Announcements

### Module 1 - Introduction to 3D Modelling

- Topic level outcomes
- Contents
- 1. Short Video on Modelling of an All-Terrain Vehicle
- 2. Significance of 3D modelling across Engineering field
- 3. Application of 3D modelling in Engineering 
  - Assessment
- 4. Difference between Sketching, Drawing and Engineering Drawing 
  - Assesment
- 5. Computer Aided Engineering Drawing
- 6. Learning by Doing
- 6. Learning by Doing (Cont'd)
- 7. Creating a 2D Drawing sheet with Isometric and Orthographic Views 
  - Assessment

### Module 2 - Introduction to Engineering Drawing

# Screenshot of UTS Learning Center

UTS

Dr Binu K G

Home ▶ My courses ▶ eBook on Engineering Graphics ▶ Module 1 - Introduction to 3D Modelling ▶ 6. Learning by Doing

NAVIGATION

Home

Dashboard

Site pages

My courses

eBook on Engineering Graphics

Participants

Badges

Competencies

Grades

Announcements

Module 1 - Introduction to 3D

Modelling

Topic level outcomes

Contents

1. Short Video on Modelling of an All-Terrain Vehicle

2. Significance of 3D modelling across Engineering...

3. Application of 3D modelling in Engineering

Assessment

4. Difference between Sketching, Drawing and Engin...

Assesment

5. Computer Aided Engineering Drawing

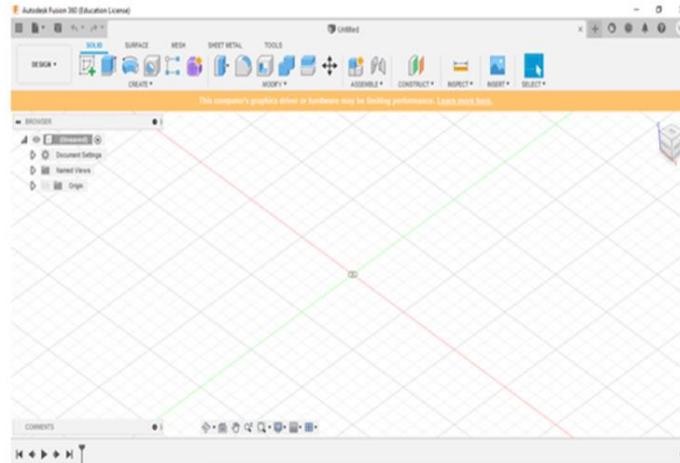
6. Learning by Doing

[Back to 'Module 1 - Introduction to 3D Modelling'](#)

## 6. Learning by Doing

### Activity 1: Introduction to Fusion 360 (set of commands)- Demonstration

In this section, Autodesk Fusion 360 software will be introduced to you. After downloading the software, you need to double click on the Fusion 360 icon which will open the main page as shown below.



# **Student and faculty feedback**

# Group 1 - feedback

Students who have completed first year using traditional method of Engineering Drawing

## Key observations



A sample of 18 students.



Students used new content in a laboratory on campus.



Prominent statements:

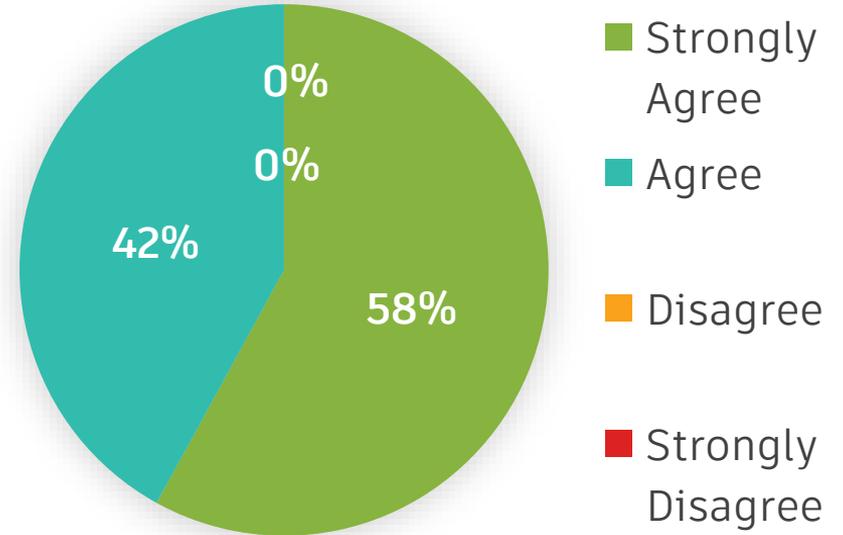
- Easier visualization.
- Provides an answer to the question “why do we need to learn this?”
- Effective approach.

# Group 1 - observations

Results of survey

## Statement

This new approach to Engineering Graphics is completely different from what I experienced when I learnt this subject earlier.



# Group 1 - other significant responses

- “Very helpful for learning projection of points and lines, as it was difficult using the old approach to visualize without 3D models”.
- “The concepts were made easy to understand with the help of illustrations and activities”.
- “Helps in describing everything with a reference, which leads to better communication of design ideas”.
- “It took some time for me to understand the flow of the learning material”.
- “Fusion 360 is very easy to learn for beginners”.
- “This method is helpful and intuitive for anyone learning CAD as a beginner. Giving open-ended assignments will be helpful”.

# Group 1 - other key observations

**89%**

## **Balance**

The theoretical concepts and practical exercises were well-balanced.

**89%**

## **Practical**

The questions / problems related to practical applications were excellent.

**58%**

## **Visualization**

The module helped me visualize and relate to the topic at hand.

**100%**

## **Quality**

The overall quality of the learning experience is excellent.

# Group 2 - feedback

New students with no prior exposure to Engineering Drawing

## Key observations



A sample of 12 students.



Students used new content in a laboratory on campus.



Prominent statements:

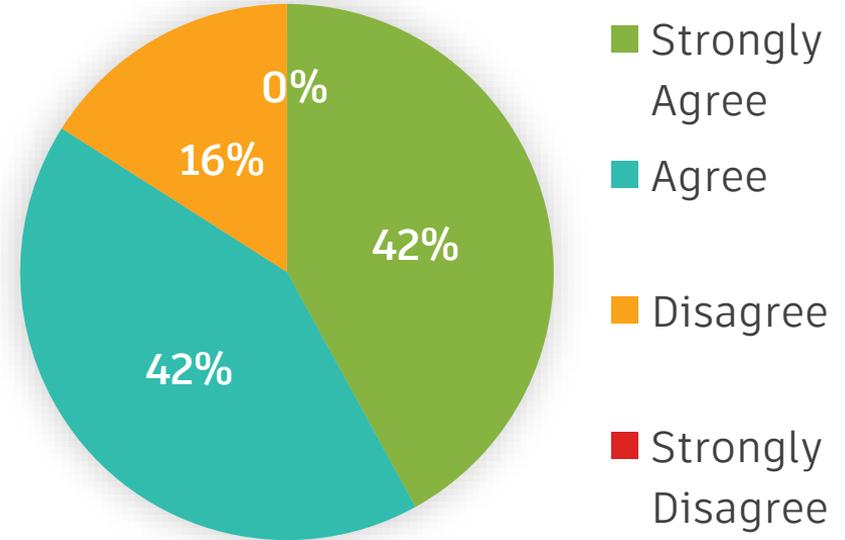
- Videos were useful in grasping the software.
- Subtitles needed.
- The content was a little hard initially but was easy to use later.

# Group 2 - observations

Results of survey

## Statement

I was able to follow the instructions and material provided easily, without any ambiguity or confusion.

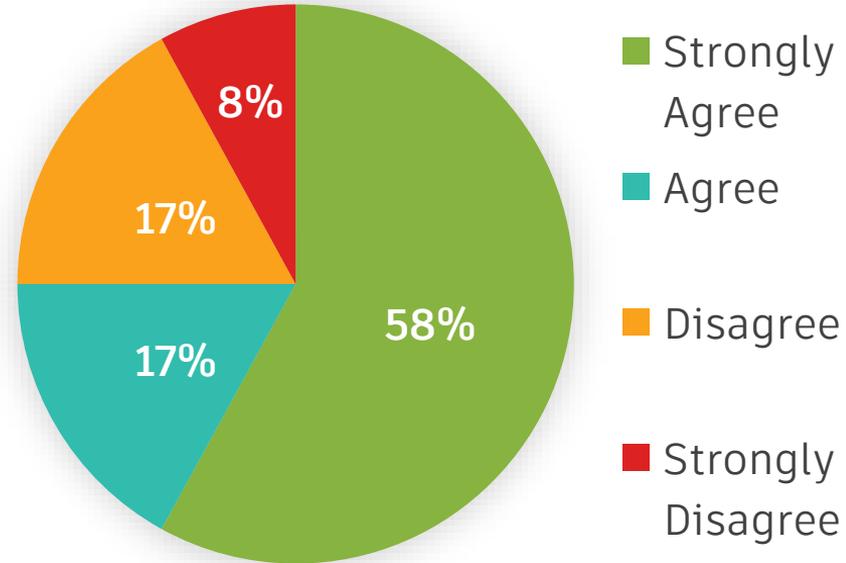


# Group 2 - observations

Results of survey

## Statement

I was able to grasp the topic at hand and visualize each step easily.



# Group 2 - other key observations

**91%**

## **Balance**

The theoretical concepts and practical exercises were well-balanced.

**92%**

## **Practical**

The questions / problems related to practical applications were excellent.

**91%**

## **Impetus**

The module has created an interest in me to learn more about the topic at hand.

**75%**

## **Quality**

The overall quality of the learning experience is excellent.

# Group 3 - feedback

Teaching faculty from various departments

## Key observations



A sample of 20 members of faculty.



Feedback was obtained in a laboratory on campus.



Prominent statements:

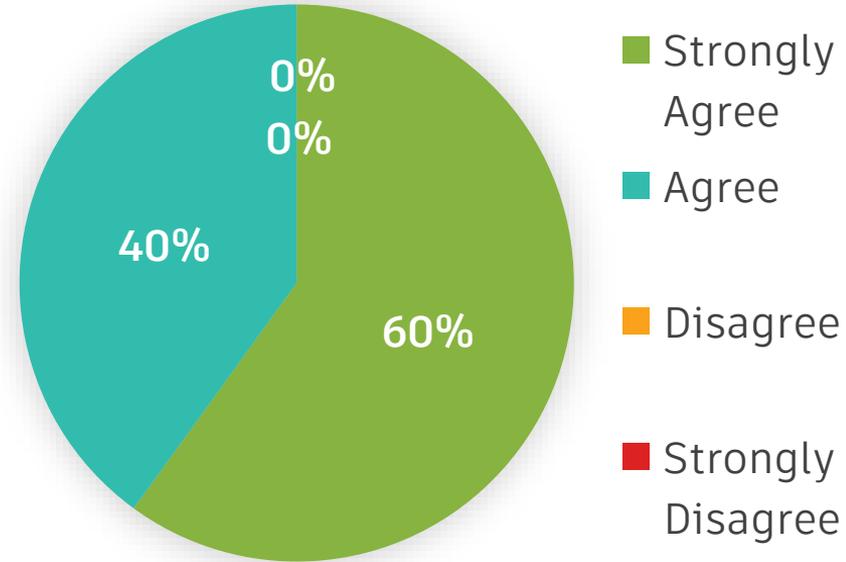
- Engaging content. Provides for effective self-paced learning.
- Effective pedagogy.
- Enables better visualization of the underlying concepts.

# Group 3 - observations

Results of survey

## Statement

The approach followed in this module was completely different from what I experienced when I learnt this subject earlier.



# Group 3 - other key observations

**62%**

## **Balance**

The theoretical concepts and practical exercises were well-balanced.

**94%**

## **Practical**

The questions / problems related to practical applications were excellent.

**69%**

## **Visualization**

The module helped me visualize and relate to the topic at hand.

**72%**

## **Quality**

The overall quality of the learning experience is excellent.

# Group 3 - other significant responses

- “The content was in a proper flow for students to understand. Specifically, the explanation of the theory and the ‘learning by doing’ concept is good”.
- “Graphical design and modeling can be understood easily by the students because of the visualization approach adopted”.
- “The drawback of classroom teaching is overcome. Students can go through the video multiple times based on their own pace”.
- “This type of learning promotes interdisciplinary collaboration in learning and promotes application in many fields”.
- “The overall content of this module is well developed. It would be better if the sketches provided are of more clarity”.

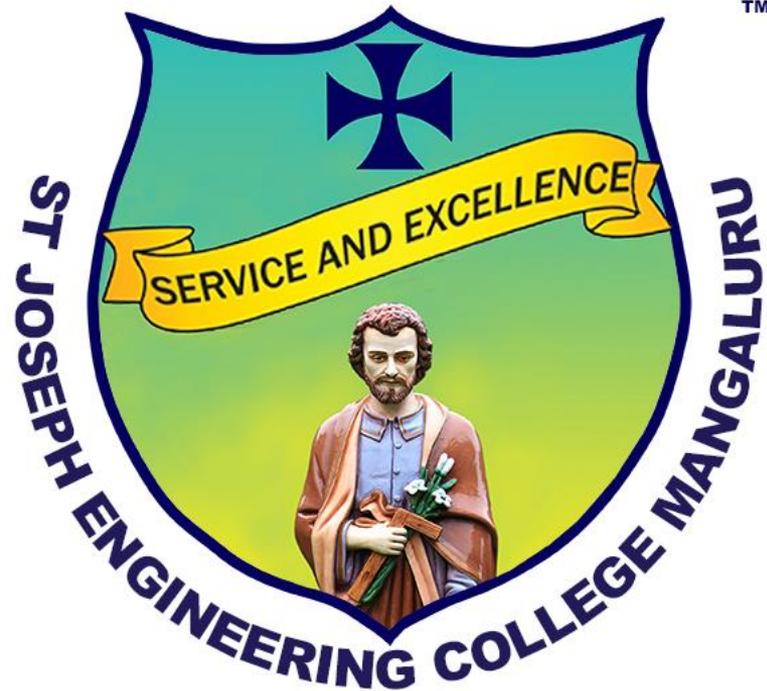


# **Development of the new approach**

# Development of the new approach

The new approach was developed at St. Joseph Engineering College - Mangaluru (SJEC) in the southern state of Karnataka, India.

The eLearning content was developed by a team of six faculty from the Department of Mechanical Engineering at SJEC in collaboration with Autodesk and UTS Inc.



# Syllabus

# Syllabus

## **Module 1: Introduction to Engineering Graphics and 3D Modeling**

Students realize the significance of 3D modeling. They develop working knowledge on Autodesk® Fusion 360®. They also learn prototyping using 3D printer.

## **Module 2: Orthographic Projections of Points and Lines in 3D**

Students understand orthographic projections. They learn to develop projections from 3D models.

## **Module 3: Orthographic Projections of Planes and Solids in 3D**

Students develop 3D models of real-world applications of planes and solids and obtain their 2D projections.

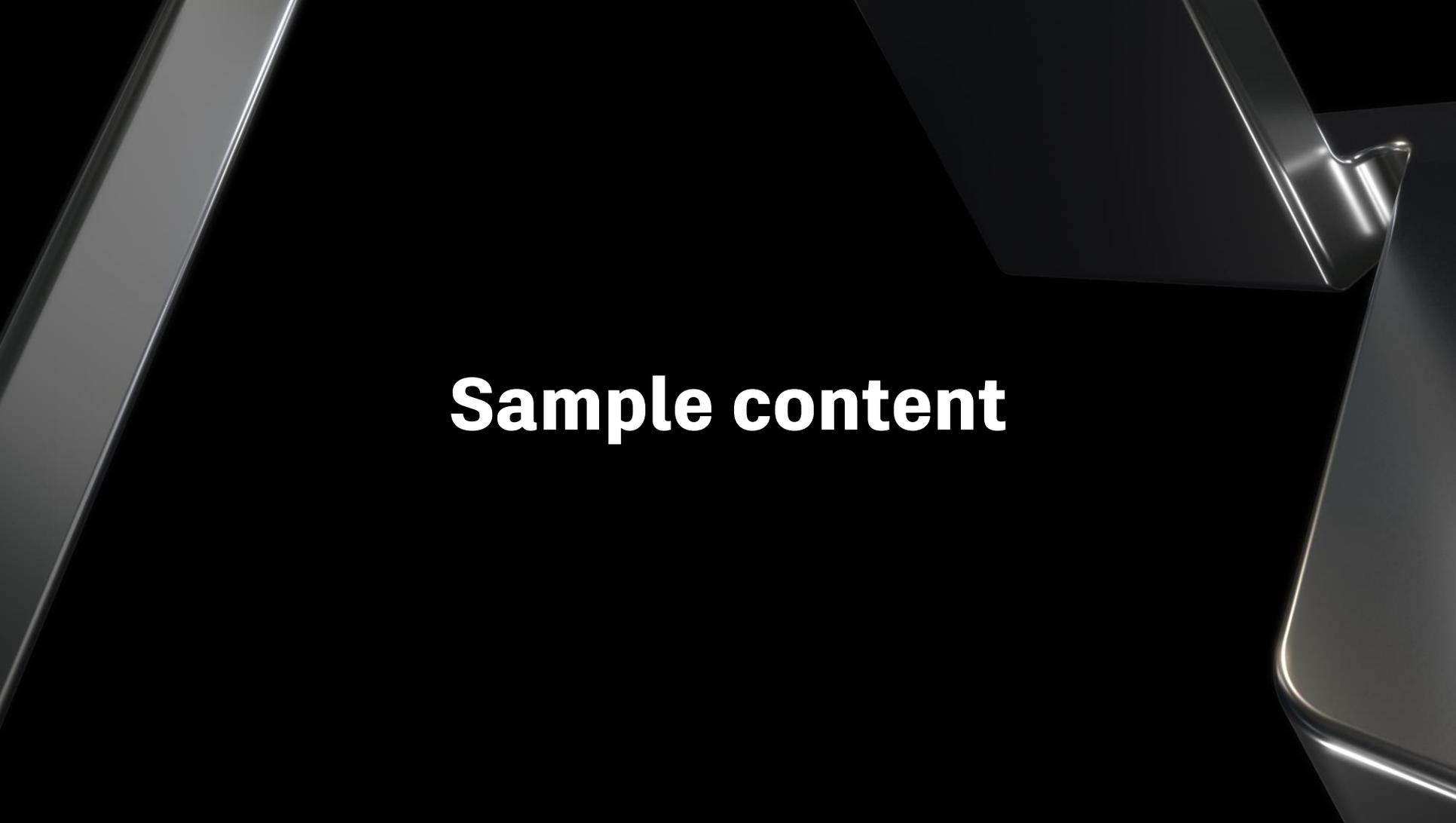
# Syllabus

## **Module 4: Isometric Projections in 3D**

Students develop isometric projections from 3D models of solids.

## **Module 5: Development of lateral surfaces**

Students develop lateral surfaces of right regular prisms, cylinders, pyramids and cones.



**Sample content**

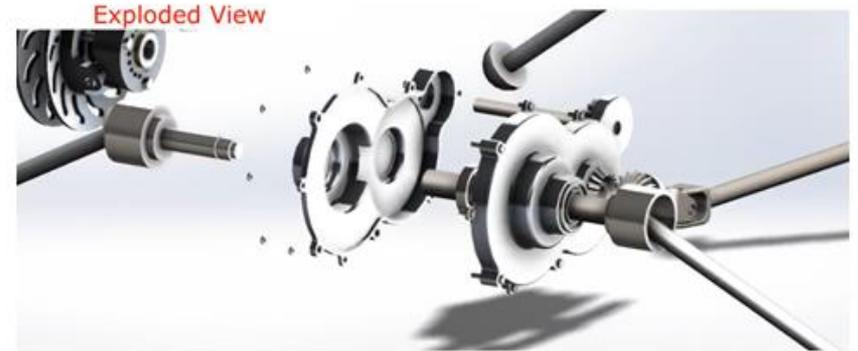
# Impetus video - 1

Introduction to Engineering Graphics - screenshots

Let us look at an  
Engineered Product



An All-Terrain Vehicle (ATV)

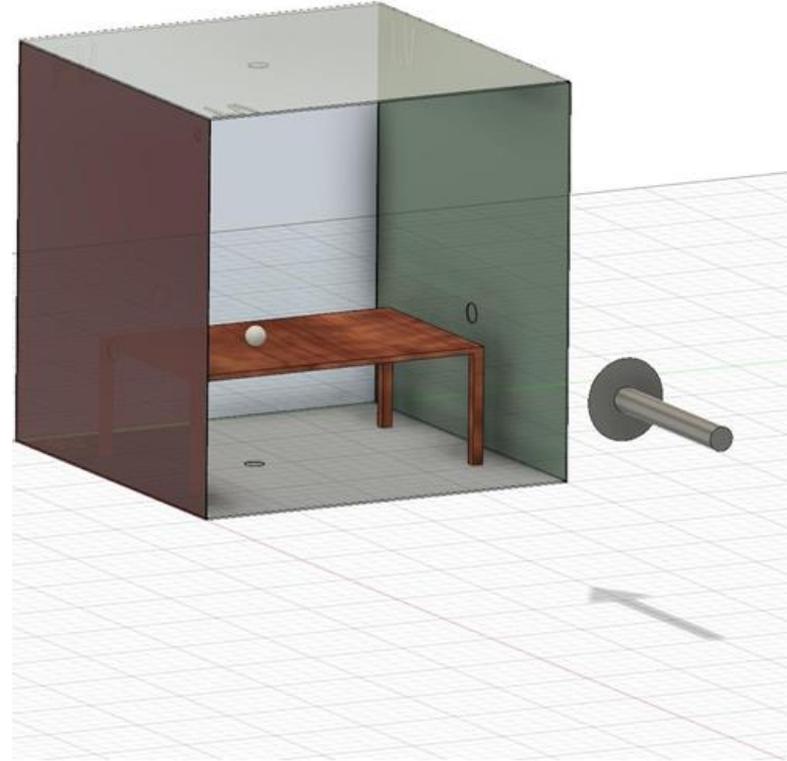


# Sample exercise in Fusion 360

**Problem statement:** A tennis ball kept on a table is at 100 cm from the front wall, 80 cm from the right-side wall and 60 cm above the floor. A boy sitting on a chair looks at the ball. Considering the boy's perspective, draw its front view, top view and side view using the orthographic projection principle.

**Illustration of the problem statement using Fusion 360.**

The modeling of the ball on the table is done as per the specified dimensions. The engineering drawing of the problem statement is obtained in 2D directly from the 3D model using Fusion 360.



# Final solution of the exercise in Fusion 360

This computer's graphics driver or hardware may be limiting performance. [Learn more here.](#)

**BROWSER**

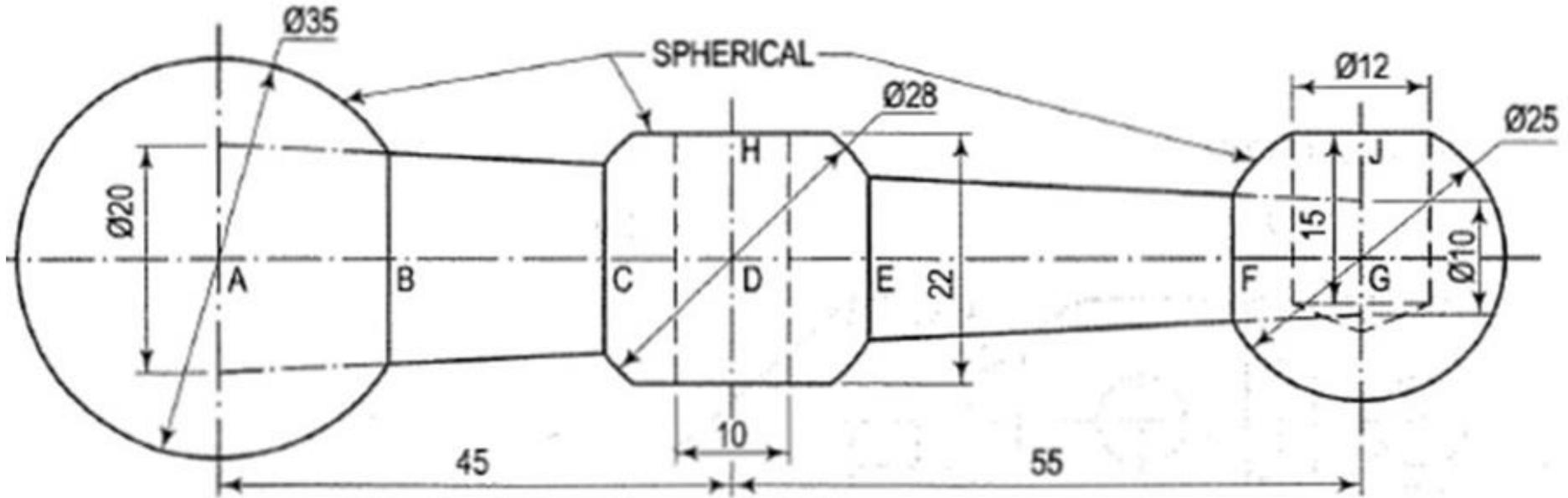
- Activity 2-ball Drawing v0
  - Document Settings
  - Sheet1
    - Sheet Settings
    - Activity 2-ball v10:1
      - Sketches
      - Component1:1
      - Component2:1
      - Component3:1
      - Component4:1
      - Component5:1
      - Component6:1
      - Component8:1
      - Component9:1

**COMMENTS**

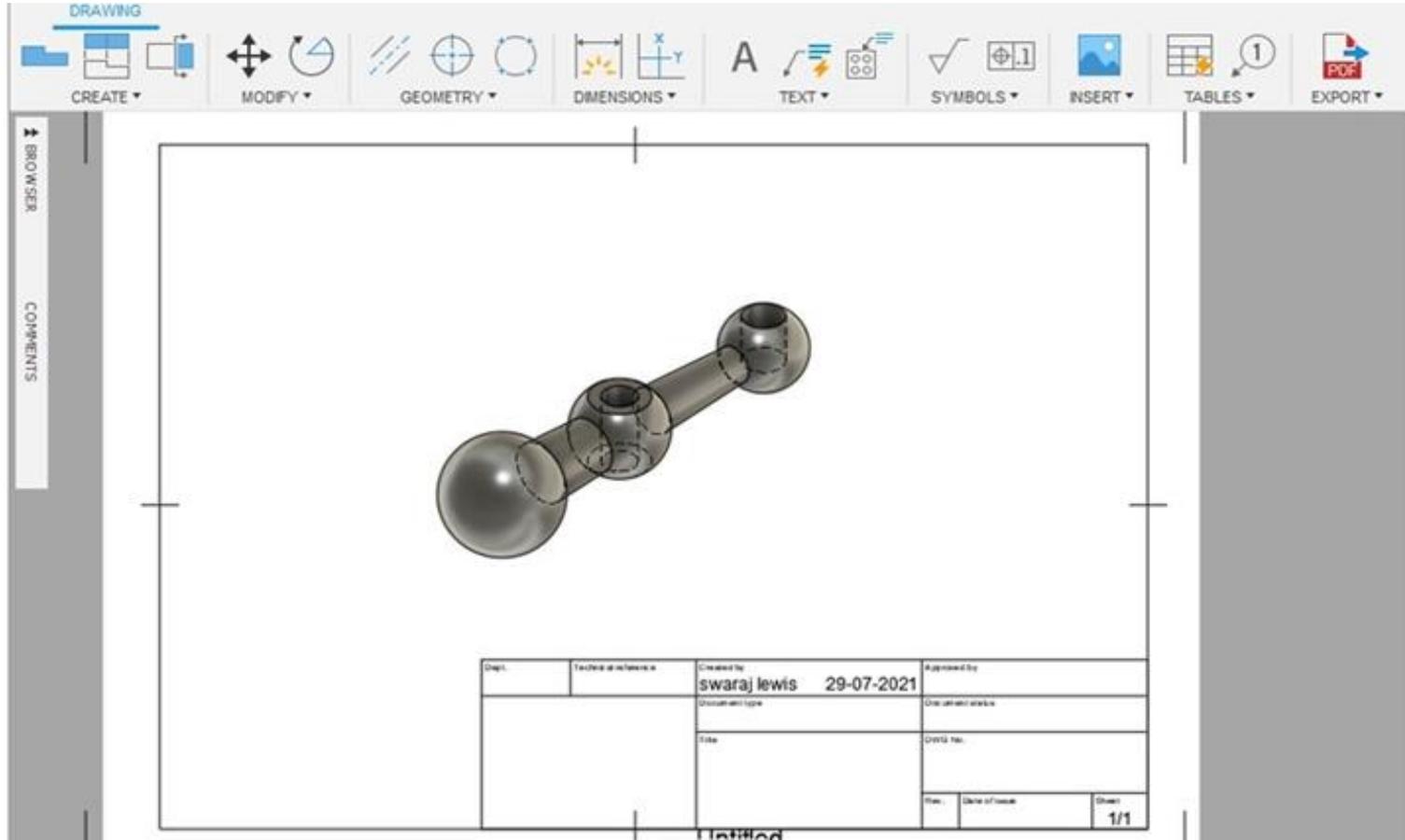
Dept	Technical/Inhouse	Created by Vijay V S	12-07-2021	Approved by
		Discipline type		Document state
		Title Activity 2-ball		DWG No.
No.	Date of Issue	Sheet	1/1	

# 2D drawing of machine handle

Students develop a 3D model and display it in an isometric view using Fusion 360



# Isometric view of the 3D model using Fusion 360



The background features a dark, almost black, gradient with sharp, diagonal metallic highlights in shades of silver and gold. These highlights create a sense of depth and movement, resembling the edges of a modern, sleek object or a futuristic architectural element. The overall aesthetic is clean, professional, and high-tech.

# **Implications of the new approach**

# Implications

## Job readiness:

Students will gain problem-solving skills, essential for job readiness.

## Multidisciplinary knowledge:

Students will experience applications of Engineering Graphics across disciplines.

## Software platform:

Students will gain exposure and competency on an industry standard modeling tool.



# Scaling plans

# Scaling plans

- Extend the approach to 14 more colleges / universities that are part of a pilot group of institutes focusing of new approach to implementation of NEP 2020.
- Revise the content as required, based on the broader feedback.
- Work with AICTE to extend it to a large number of engineering colleges and polytechnics in India.
- Do further development for linking mathematical modeling using TK Solver to graphical modeling using Fusion 360 for other levels of engineering curriculum.

# Summary

# Summary

- Very encouraged with the response of all stakeholders.
- Content being revised based on the feedback.
- Students are more motivated.
- New approach to engineering education is possible.
- Potential for enhancing employability of fresh graduates.

# Aligned with the NEP 2020

PM Modi on National Educational Policy 2020

“The New Education Policy (NEP) focuses on the foundational learning and languages. It also focuses on the learning outcomes and teacher training.

Reforms in the NEP have been made keeping in mind access and assessment. The NEP shows a way to empower every student”.



सत्यमेव जयते

## National Education Policy 2020

Ministry of Human  
Resource Development

Government of India

The background features a dark, almost black, space filled with several large, metallic, 3D-rendered geometric shapes. These shapes, which resemble stylized letters or architectural components, are positioned in the corners and along the edges, creating a sense of depth and modernity. The lighting highlights the sharp edges and reflective surfaces of these objects.

# AUTODESK UNIVERSITY

Autodesk and the Autodesk logo are registered trademarks or trademarks of Autodesk, Inc., and/or its subsidiaries and/or affiliates in the USA and/or other countries. All other brand names, product names, or trademarks belong to their respective holders. Autodesk reserves the right to alter product offerings, specifications and pricing at any time without notice, and is not responsible for typographical or graphical errors that may appear in this document.

© 2021 Autodesk. All rights reserved.