DAYANANDA SAGAR UNIVERSITY
SCHOOL OF ENGINEERING

Department of Mechanical Engineering

Devarakaggalahalli, Harohalli, Kanakapura Road, Bengaluru South District, Karnataka – 562 112

Engineering Graphics & Generative Design
For Computer Science Cluster

(As per Choice Based Credit System)

Course Code: 26XXXXX
Semester: 1 / 2
Programs Offered: B.Tech (CSE Cluster)
Prerequisites: NIL
Course Type: Engineering Science Course (ESC)
Credits: 3
L – T – P – J: 2 – 0 – 2 – 0 (2 Credit Theory + 1 Credit Lab)
Software Platform: Autodesk Fusion 360
Programming Language: Python
Contact Hours: 60 Hours

Course Vision

This course introduces engineering graphics, parametric modeling, and generative design integrated with computational thinking and automation. It enables CSE students to bridge design and programming through CAD tools, AI-assisted workflows, and Fusion API-based automation.

Course Objectives

Students will be able to:

- To develop fundamental understanding of engineering graphics and visualization
- To enable creation of parametric 2D and 3D CAD models
- To introduce AI-driven generative design concepts
- To apply programming concepts for CAD automation using Fusion API
- To build computational design and automation skills

Course Outcomes (COs)

CO No.	Description	Bloom's Taxonomy Level
CO1	Apply engineering graphics principles and CAD tools to create accurate 2D sketches and technical drawings	L3 – Apply

CO2	Develop parametric 3D models and assemblies using feature-based CAD modeling techniques	L3 – Apply
CO3	Analyze and interpret generative design outputs for optimized and lightweight engineering solutions	L4 – Analyze
CO4	Implement CAD automation solutions using Python scripting and Fusion API tools	L3 – Apply
CO5	Design and apply computational workflows for automated and data-driven CAD design systems	L3 – Apply

Broad Course Description

This course introduces the fundamentals of engineering graphics, parametric modeling, and generative design with a strong emphasis on computational thinking and automation. It is specifically designed for CSE cluster students to bridge the gap between design and programming by integrating CAD tools, AI-assisted workflows, and API-based development.

Students begin with engineering drawing principles and 2D sketching, progressing to parametric 3D modeling and assemblies. The course then explores generative design, where AI-driven techniques are used to create optimized and innovative design solutions based on constraints and objectives. Further, students learn to program and automate CAD tasks using Fusion API and Python, enabling the development of intelligent design systems.

By the end of the course, students will be able to create, analyze, and automate design processes, develop data-driven and parametric models, and apply computational approaches to real-world engineering design problems. The course emphasizes both **AI integration** and **authentic intelligence**, ensuring students not only use intelligent tools but also critically interpret and validate their outputs.

Detailed Course Syllabus

Module 1: Engineering Graphics & 2D Sketching (12 Hours)

Engineering graphics fundamentals, BIS standards, drawing conventions, Orthographic projections, sectional views, isometric views, CAD interface and sketch environment, 2D sketching: tools, constraints, dimensioning
Engineering Applications: Technical drawing and documentation

Module 2: 3D Modeling (12 Hours)

Parametric and feature-based modelling, Solid modeling: extrude, revolve, sweep, loft, Feature modifications and assemblies
Engineering Applications: Product design and digital prototyping

Module 3: Generative Design (12 Hours)

Generative design concepts and workflows, Constraints, materials, loads, Optimization and validation.

Engineering Applications: Lightweight and optimized structures

Module 4: Fusion API & CAD Programming (12 Hours)

Introduction to APIs and Fusion API architecture, Python scripting fundamentals for CAD, Accessing and modifying sketches, features, and parameters, Automating 2D/3D model creation using scripts, Event handling and UI basics in Fusion, Debugging and execution workflows

Engineering Applications: Automated CAD model generation, parametric script-based design, Custom CAD tool development

Module 5: Design Automation & Computational Design (12 Hours)

Design automation workflows and pipelines, Parametric and rule-based design systems, Generating design variants using code, Data-driven design (inputs → geometry), Introduction to add-in development, CAD + data + automation integration

Engineering Applications: Mass customization systems, automated design exploration tools Smart CAD applications

Strength of CO Mapping to PO/PSOs:

Table: Mapping Levels of Cos to POs / PSOs

COs	Program Outcomes (POs)											PSOs	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3	2	1	-	1	-	-	-	-	2	-	2	1
CO2	3	3	2	-	1	-	-	-	-	1	-	2	1
CO3	2	1	2	-	3	-	-	-	1	2	-	3	2
CO4	2	2	3	2	3	1	2	-	1	1	-	3	3
CO5	1	-	1	-	2	-	-	1	2	3	1	1	2
AVG	11/15	8/15	9/15	2/15	10/15	1/15	2/15	1/15	4/15	9/15	1/15	11/15	9/15

3: Substantial (High) 2: Moderate (Medium) 1: Poor (Low)

AI Integration & Authentic Intelligence Reflection (AI² Pedagogy)

AI Integration:

Module-1: Use AI-assisted CAD and drafting tools such as Autodesk Fusion 360 and AutoCAD to generate, validate, and optimize engineering drawings, projections, and 2D sketches.

Module-2: Apply AI-enabled parametric modelling and assembly tools for intelligent feature creation, constraint management, interference detection, and rapid digital prototyping.

Module-3: Use AI-powered generative design platforms for topology optimization, lightweight structure development, material selection, and performance-based design validation.

Module-4: Integrate AI coding assistants and Python scripting tools to automate CAD modelling, feature generation, parametric modifications, and Fusion API workflows.

Module-5: Apply AI and computational design techniques to develop rule-based automation systems, generate design variants, and create intelligent CAD-driven workflows.

Authentic Intelligence Reflection:

Module-1: AI integration improves visualization, drafting accuracy, and technical documentation skills through intelligent CAD-based learning approaches.

Module-2: AI-assisted modelling enhances product development, assembly analysis, and digital prototyping skills aligned with modern engineering industries.

Module-3: AI integration enables data-driven optimization, sustainable design exploration, and computational engineering problem-solving.

Module-4: AI-supported CAD programming strengthens automation, scripting, computational thinking, and Industry 4.0 design capabilities.

Module-5: AI-driven computational design promotes smart automation, mass customization, and intelligent engineering workflow development for advanced digital manufacturing.

Laboratory Component (1 Credit)

The laboratory component focuses on Autodesk Fusion 360 and Python-based automation.

Lab Experiments (Indicative):

1. **2D Sketching:** Creating sketches with auto-dimensioning and sketch recognition tools.
2. **3D Modeling:** Developing parametric 3D models using extrude, revolve, and assembly constraints.
3. **Generative Design:** Applying AI-driven exploration based on materials, loads, and constraints.
4. **Fusion API Scripting:** Writing Python scripts to access and modify CAD parameters and automate model creation.
5. **Design Automation:** Building rule-based design systems and parametric product configurators.
6. **Advanced Automation:** Using AI-assisted code generation and debugging to optimize Python-based CAD scripts.

AI-Integrated Lab Exercises (Indicative)

- **Exercise 1 (Visualization):** Use AI-based visualization for orthographic, sectional, and isometric views.
- **Exercise 2 (Optimization):** Use cloud-based generative design tools for performance prediction and structural optimization.
- **Exercise 3 (Automation):** Implement AI-assisted code generation for CAD scripting and automate parametric modeling workflows.
- **Exercise 4 (Validation):** Critically evaluate AI-generated designs against engineering standards (e.g., BIS standards) and manufacturability.

The course emphasizes that students must **debug AI-generated scripts**, validate automation logic, and analyze trade-offs between performance and complexity

Assessment Scheme

Definitions

1. Internal Assessment (CIA) – 60 Marks

a. One **Mid Semester Examination (MSE)** (CAD Tool-based, Laboratory Exercises),

b. One **Continuous Assessment Tool (CAT)**: It may include: Surprise test (Computer-based), Quiz, Project based learning, Reflection Note on Guest Lecture, Industrial visit, E-course certification, Building models, Group discussion, Case study, Assignment, Seminar, or Open Book Assignment.

c. One **AI-powered Assignment (APA):** Use of AI tools for problem-solving while simultaneously developing Authentic Intelligence through critical evaluation, ethical reasoning, and responsible decision-making.

OR

d. **Mini Project:** Lightweight generative structural component design.

2. **"External Assessment"** refers to the Semester End Examinations (SEE). The weightage of this component is **40%**. At the end of semester, the final examination is conducted to evaluate student's performance.

1. Internal Assessment (CIA) – 60 Marks

Component	Marks	Modules
One MSE	30	Module 1 & 2
CAT – Assignment/Seminar/Project	10	Module 1,2,4 & 5
Mini Project	20	Module 3
Total	**60**	—

2. External Assessment (SEE) – 40 Marks

Component	Marks	Module
Exercise 1 Using CAD Tool	20	Module 1 & 2
Exercise 2 Using CAD Tool	20	Module 4 & 5
Total	**40**	

Recommended Tools

- CAD Software: Autodesk Fusion
- Simulation: Generative design tools, CAD simulation modules
- Programming: Python (Fusion API)
- AI Tools: ChatGPT, CAD plugins

Suggested Reading

Textbooks

1. K. Venugopal and V. Prabhu Raja, *Engineering Drawing and Graphics*, New Age International Publishers.
2. Sham Tickoo, *Autodesk Fusion 360 for Designers*, CADCIM Technologies.
3. Randy H. Shih, *Parametric Modelling with Autodesk Fusion 360*, SDC Publications.
4. Eric P. Sarriegu, *Fusion 360 API Programming*, Packt Publishing.

Reference Books

1. Ibrahim Zeid, *CAD/CAM: Theory and Practice*, McGraw Hill.
2. Ian Stroud and Henry Nagy, *3D Modelling and CAD Systems*, Springer.
3. P. N. Rao, *CAD/CAM: Principles and Applications*, McGraw Hill Education.
4. Art Wetmore, *Mastering Autodesk Fusion 360*, Autodesk Press.
5. Wassim Jabi, *Parametric Design for Architecture*, Laurence King Publishing.
6. John M. Snyder and Alan H. Barr, *Ray Tracing Complex Models Containing Surface Tessellations*, ACM Press.

Additional Learning Resources

- NPTEL – Engineering Graphics and CAD
- Autodesk Learning Resources (Fusion 360 official tutorials)
- Coursera / edX / Udemy MOOCs on CAD, Generative Design, and Computational Design
- Research papers from IEEE Xplore / ScienceDirect (for advanced exploration)

Mapped NVIDIA DLI Course

Course Title: Fundamentals of Deep Learning OR Computer-Aided Engineering (Simulation & Digital Twins)
Focus: Understanding how neural networks and parallel processing (CUDA) accelerate design validation and generative iterations.
Relevance: This course provides the foundational knowledge needed to understand the "AI Logic" (Input → Weighted Sum → Activation) mentioned in your syllabus's AI Integration section.

DLI Learning Path for Engineering Design

This path is designed to transition students from traditional CAD to AI-accelerated generative workflows.

Week Wise Lesson Plan

Week	Session	Topic	Lab Activity	Teaching Method	AI Integration	Expected Learning Outcome
1	1	Introduction to Engineering Graphics	CAD interface familiarization	Demo	AI UI assist	Understand CAD environment

	2	CAD Interface & Workspace Navigation	Navigation and workspace setup	Practice	Smart navigation hints	Navigate CAD software efficiently
	Lab	Basic CAD operations and sketch environment	Create simple sketches and save files	Hands-on	Auto-sketch suggestions	Create and manage CAD files
2	3	BIS Standards & Drawing Conventions	Technical drawing setup	Lecture + Demo	AI drafting support	Apply drawing standards
	4	Basic Sketch Tools & Geometry	Create lines, circles, rectangles	Practice	Geometry recognition	Develop basic sketches
	Lab	2D sketching exercises	Prepare engineering sketches	Hands-on	Smart sketch assist	Generate accurate 2D sketches
3	5	Constraints in Sketching	Constraint application exercise	Lecture + Practice	Smart constraints	Apply geometric constraints
	6	Dimensioning Techniques	Dimensioning practice	Practice	AI dimension suggestions	Apply dimensions correctly
	Lab	Constraint and dimensioning exercises	Fully constrained sketches	Hands-on	AI validation assist	Create fully defined sketches
4	7	Orthographic Projections	Orthographic drawing creation	Demo	AI view generation	Understand orthographic views
	8	Sectional Views and Isometric Views	Engineering drawing visualization	Practice	AI section assist	Interpret engineering drawings
	Lab	Engineering drawing generation	Generate complete drawings	Hands-on	Auto drawing generation	Prepare technical drawings
5	9	Parametric Modeling Concepts	Parameter editing exercise	Demo	AI parametric hints	Understand parametric modeling

	10	Feature-Based Modeling	Create parameter-based models	Practice	Feature prediction	Develop parametric models
	Lab	Parametric sketch and model creation	Model parameter updates	Hands-on	Smart parameter control	Control geometry using parameters
6	11	Extrude Features	Extrude operation practice	Lecture + Demo	Feature recognition	Create solid models
	12	Revolve, Sweep and Loft Features	Complex feature modeling	Practice	AI feature suggestions	Generate advanced 3D parts
	Lab	3D part modeling	Create solid components	Hands-on	Automated feature hints	Develop 3D CAD models
7	13	Feature Modification Tools	Fillet, chamfer, shell operations	Lecture + Practice	Smart feature assist	Modify solid models
	14	Assembly Modeling Concepts	Assembly constraint applications	Demo	AI assembly assist	Understand assembly workflow
	Lab	Assembly modeling exercise	Multi-component assembly	Hands-on	AI alignment assist	Create functional assemblies
8	15	Introduction to Generative Design	Generative workflow setup	Lecture + Demo	AI optimization engine	Understand generative workflows
	16	Design Constraints, Loads & Materials	Material and load definition	Practice	AI material recommendation	Apply design conditions
	Lab	Generative design study	Generate optimized concepts	Hands-on	AI-generated concepts	Explore optimized solutions
9	17	Optimization Techniques	Design optimization workflow	Demo	AI performance ranking	Understand optimization

	18	Validation of Design Outcomes	Result comparison exercises	Analysis	AI evaluation support	Analyze generated designs
	Lab	Optimization case study	Compare optimized models	Hands-on	AI analysis assist	Evaluate design performance
10	19	Lightweight Structures	Lightweight component design	Lecture + Practice	AI topology suggestions	Develop lightweight structures
	20	Industrial Applications of Generative Design	Industrial case discussion	Discussion	AI industrial examples	Understand real-world applications
	Lab	Lightweight design exercise	Optimized component modeling	Hands-on	AI structural assist	Create efficient structures
11	21	Introduction to APIs	API environment setup	Demo	AI code assist	Understand API basics
	22	Fusion API Architecture	API object exploration	Practice	Smart API guidance	Understand API workflow
	Lab	API environment exploration	Access CAD objects	Hands-on	AI code hints	Explore Fusion API tools
12	23	Python Fundamentals for CAD	Basic Python scripting	Lecture + Practice	AI code completion	Develop scripting fundamentals
	24	Variables, Functions & Logic	Python programming exercises	Practice	AI syntax suggestions	Write simple programs
	Lab	Python scripting exercises	Create basic CAD scripts	Hands-on	AI debugging support	Develop CAD scripts
13	25	Accessing Sketches & Features via API	Sketch automation workflow	Demo	Script generation support	Automate sketch creation

	26	Automating 3D Modeling	Script-based feature creation	Practice	AI feature coding	Automate 3D modeling
	Lab	Automated model generation	Generate models through code	Hands-on	AI model generation	Create automated CAD models
14	27	Event Handling & UI Basics	UI command creation	Demo	AI UI templates	Understand UI development
	28	Debugging & Execution Workflows	Script debugging practice	Practice	AI debugging support	Troubleshoot scripts
	Lab	Custom CAD command exercise	Build simple CAD tools	Hands-on	Smart code correction	Develop CAD utilities
15	29	Design Automation Concepts & Rule-Based Design	Workflow automation exercises	Lecture + Practice	AI workflow generation	Understand automation concepts
	30	Computational & Data-Driven Design	Variant generation using code	Practice	AI variant generation	Develop computational design workflows
	Lab	Mini project implementation and presentation	Automated CAD project demonstration	Project-Based Learning	AI project suggestions	Demonstrate complete automated CAD solution

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