

Subject: Visualizing Engineering Concepts-DET1ME12202

Type of course: Minor

Prerequisite: Basic Knowledge of Engineering Drawing

Rationale:

The main objective of this course is to develop the skills regarding various modeling and digital production drawings as required by the industry using appropriate CAD software. This program provides students with a strong foundation in design principles, 2D/3D modeling, drafting, and simulation. It enables them to bridge the gap between conceptual product design and practical manufacturing execution. The curriculum integrates theoretical knowledge with practical skills using industry-standard software such as AutoCAD.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks		Total Marks
CI	T	P		SEE	CCE	
4	0	2	5	100	50	150

Legends: CI-Class Room Instructions; T – Tutorial; P - Practical; C – Credit; SEE - Semester End Evaluation; CCE-Continuous and Comprehensive Evaluation.

Course Content:

Sr. No	Course content	Hrs.	% Weight age
1	<p>Introduction to Drawing What is a drawing, Uses, Elements of Graphics, Methods of Expression, Methods of Size Description, Methods of Preparing Drawings, Types of Mechanical Drawings, Drawing Standards.</p> <p>Practical:</p> <ol style="list-style-type: none"> 1) Identify and label elements of a standard mechanical drawing. 2) Practice on size description using dimensioning methods (linear, angular, aligned, etc.) 3) Identify and understand symbols and conventions used in technical drawings. 	T: 06 P: 08	20%

4) Create a title block and understand standard sheet layouts.
 5) Analyze real-world machine drawings and list their components.

Evaluation Method:

Sr. No.	Evaluation Methods	SEE	CCE
1	Drawing Standards and Layout Assessment	10	
2	Application of Drawing Standards, Dimensioning, and Title Block in CAD	10	
3	Drawing Identification and Classification Exercise		10
	Total	20	10

Examination Style:

Students will be given a CAD template. It is required to identify and apply standard symbols and conventions as per BIS/ISO guidelines. demonstrate proper dimensioning techniques (linear, aligned, angular) on a given sketch or component and design and complete a standard title block with accurate sheet layout, borders, and required details (title, scale, date, drawn by, etc.).

Continuous Assessment Examination

Drawing Identification and Classification Exercise (10 marks)

Faculty gives the task to each student. Students required to label key elements of a given sample drawing, including the title block, views, scale, borderlines, and commonly used symbols. They need to identify the applicable drawing standard (such as BIS or ISO) and classify the type of drawing. Upload pdf file on GMIU portal.

2	Computer Aided Drafting Basic information of AutoCAD software, computer configuration, working of various function keys, coordinate system, AutoCAD programme window, basic AutoCAD Commands- Units, Line, Circle, Arc, Rectangle, Polyline, Polygon, Array, etc. 2D Modify/Edit commands- Erase, Copy, Move, Offset, Mirror, Trim, Rotate, Extend, Chamfer, Fillet, Scale, etc. Drafting setting commands- Grid, Snap, Polar tracking, OSnap, Ortho, Dynamic input, Units, etc. 3D primitives- Box/Cube, Cylinder, Cone, Pyramid, Wedge, Torus, etc. 3D commands- Revolve, Sweep, Loft, Press pull, Extrude, etc. 3D Modify- 3D Array, 3D Mirror, 3D	T: 04 P: 10	20%
---	---	----------------	-----



<p>Rotate, Union, Subtract, Intersect, etc.</p> <p>Practical:</p> <ol style="list-style-type: none"> 1) Basic Drawing with Line and Circle Commands. 2) Generate objects with mixed geometries using polyline, polygon, and arc commands. 3) Create circular and rectangular arrays for repetitive elements like bolt holes. 4) Learn to manipulate object using move, copy, and erase commands. 5) Apply mirror and trim to create balanced and clean 2D drawings. 6) Apply chamfer and fillet on intersecting line to round and bevel edges. 7) Modify object orientation with Using rotate, scale, and extend commands. 8) Explore how to improve drawing speed and accuracy using polar tracking, ortho &osnap. <p>Evaluation Method:</p> <table border="1"> <thead> <tr> <th>Sr. No.</th><th>Evaluation Methods</th><th>SEE</th><th>CCE</th></tr> </thead> <tbody> <tr> <td>1</td><td>2D Component Layout Drawing</td><td>20</td><td></td></tr> <tr> <td>2</td><td>AutoCAD Command Identification</td><td></td><td>05</td></tr> <tr> <td>3</td><td>Viva</td><td></td><td>05</td></tr> <tr> <td></td><td>Total</td><td>20</td><td>10</td></tr> </tbody> </table> <p>Examination Style:</p> <p>2D Component Layout Drawing (20 Marks) Students will be given a 2D machine part drawing. They are required to recreate the given machine part drawing using AutoCAD (or similar software) by applying appropriate 2D drafting tools and modification commands.</p> <p>Continuous Assessment Examination</p> <p>Identify AutoCAD Commands from a given Machine Drawing (05 marks) Identify and List AutoCAD Commands Used for a Given Machine Drawing Component.</p> <p>Viva of Unit 1 (05 marks) Five viva questions should be asked from this unit to assess students' recall and understanding of the concepts.</p>	Sr. No.	Evaluation Methods	SEE	CCE	1	2D Component Layout Drawing	20		2	AutoCAD Command Identification		05	3	Viva		05		Total	20	10	
Sr. No.	Evaluation Methods	SEE	CCE																		
1	2D Component Layout Drawing	20																			
2	AutoCAD Command Identification		05																		
3	Viva		05																		
	Total	20	10																		



<p>2D Drafting and dimensioning using AutoCAD: 2D views: Front, Top, Side views, Types of dimensions: Linear, Aligned, Angular, Radius, Diameter, Baseline, Continue, Dimensioning rules, placement, and tolerances, Dimension styles and Dimension layer, Leader lines, and Engineering notes, Plotting, Printing & Exporting.</p> <p>Practical:</p> <ol style="list-style-type: none"> 1) Drafting Front, Top, and Side views of a given mechanical component. 2) Apply linear and aligned dimensions to a 2D drawing. 3) Dimensioning circular features using Radius and Diameter tools. 4) Add angular dimensions to arcs and angled features. 5) Use of Baseline and Continue dimensioning techniques. 6) Create and apply custom dimension styles. 7) Manage dimensions using layers. 8) Add Leader Lines and Engineering Notes to drawings. 9) Plot and Print drawing with proper layout and scale. 10) Export a final drawing to pdf and other formats. <p>Evaluation Method:</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center; padding: 2px;">Sr. No.</th><th style="text-align: center; padding: 2px;">Evaluation Methods</th><th style="text-align: center; padding: 2px;">SEE</th><th style="text-align: center; padding: 2px;">CCE</th></tr> </thead> <tbody> <tr> <td style="text-align: center; padding: 2px;">1</td><td style="text-align: center; padding: 2px;">Drafting and Dimensioning using AutoCAD</td><td style="text-align: center; padding: 2px;">20</td><td style="text-align: center; padding: 2px;"></td></tr> <tr> <td style="text-align: center; padding: 2px;">2</td><td style="text-align: center; padding: 2px;">2D Drawing Analysis for Dimensioning and Standards</td><td style="text-align: center; padding: 2px;"></td><td style="text-align: center; padding: 2px;">10</td></tr> <tr> <td style="text-align: center; padding: 2px;"></td><td style="text-align: center; padding: 2px;">Total</td><td style="text-align: center; padding: 2px;">20</td><td style="text-align: center; padding: 2px;">10</td></tr> </tbody> </table> <p>Examination Style:</p> <p>2D Drafting and Dimensioning of a Machine Component using AutoCAD(20 Marks)</p> <p>Students will be provided with a 2D drawing (either printed or digital) of a mechanical component. They are required to recreate the Front, Top, and Side views of the component using AutoCAD, and apply appropriate dimensions, leader lines, and annotations as per standard drafting practices.</p> <p>Active Learning Activity of Unit 3</p> <p>2D Drawing Analysis for Dimensioning and Standards (10 marks)</p> <p>Analysis of a 2D Mechanical Drawing for Dimensioning and Drafting Standards.</p>	Sr. No.	Evaluation Methods	SEE	CCE	1	Drafting and Dimensioning using AutoCAD	20		2	2D Drawing Analysis for Dimensioning and Standards		10		Total	20	10	<div style="display: flex; justify-content: space-between;"> T: 06 20% </div> <div style="display: flex; justify-content: space-between;"> P: 16 </div>
Sr. No.	Evaluation Methods	SEE	CCE														
1	Drafting and Dimensioning using AutoCAD	20															
2	2D Drawing Analysis for Dimensioning and Standards		10														
	Total	20	10														



4	<p>3D Modeling – 1: Auto CAD</p> <p>3D modeling from 2D drafting, 3D modeling using commands: Extrude, Presspull, Revolve, Thicken, Region, Solid editing operations: Union, Subtract, Intersect, Fillet Edge, Chamfer Edge, Shell, 3D Primitives: Box, Cylinder, Cone, Sphere, Torus, Wedge, Navigation and Visual Styles: Orbit, Pan, Zoom, ViewCube, Conceptual & Realistic styles, View generation: Flatshot, Sectionplane.</p> <p>Practical:</p> <ol style="list-style-type: none"> 1) Create a 3D Model from 2D Drafting using EXTRUDE. 2) Create Revolved 3D Objects using REVOLVE Command. 3) Forming 3D Shapes using the PRESSPULL and THICKEN Commands. 4) Create Complex 3D Models using REGION and EXTRUDE. 5) Construct 3D Models with Primitives: Box, Cylinder, Cone, Sphere, Torus, Wedge. 6) Modify 3D Solids using UNION, SUBTRACT, and INTERSECT. 7) Apply FILLETEDGE, CHAMFEREDGE, and SHELL to 3D Models. 8) Navigate 3D Models using ORBIT, PAN, ZOOM, and ViewCube. 9) Change Visual Styles: Wireframe, Conceptual, and Realistic. 10) Generate 2D Views from 3D Models using FLATSHOT and SECTIONPLANE. 11) Plot and Export 3D Models to PDF or other formats. <p>Evaluation Method:</p> <table border="1"> <thead> <tr> <th>Sr. No.</th><th>Evaluation Methods</th><th>SEE</th><th>CCE</th></tr> </thead> <tbody> <tr> <td>1</td><td>3D Solid Modeling: AutoCAD</td><td>20</td><td></td></tr> <tr> <td>2</td><td>3D Feature Identification from 2D Multi view Drawing</td><td></td><td>10</td></tr> <tr> <td></td><td>Total</td><td>20</td><td>10</td></tr> </tbody> </table> <p>Examination Style:</p> <p>3D Solid Modeling a given Mechanical Component using AutoCAD (20 Marks)</p> <p>Students will be given a 2D multiview drawing or part description and are required to create a 3D model using appropriate AutoCAD commands and primitives. They must apply solid editing operations</p>	Sr. No.	Evaluation Methods	SEE	CCE	1	3D Solid Modeling: AutoCAD	20		2	3D Feature Identification from 2D Multi view Drawing		10		Total	20	10	T: 06 P: 16	20%
Sr. No.	Evaluation Methods	SEE	CCE																
1	3D Solid Modeling: AutoCAD	20																	
2	3D Feature Identification from 2D Multi view Drawing		10																
	Total	20	10																



	<p>like Union, Subtract, Fillet Edge, and Chamfer Edge as needed. Students needs to generate 2D views using Flatshot or Sectionplane and plot or export the final model in the required format.</p> <p>Active Learning Activity of Unit 4</p> <p>3D Feature Identification from 2D Multiview Drawing (10 marks)</p> <p>Students will be given a 2D multiview mechanical drawing (front, top, and side views) and are required to analyze it to identify the 3D primitives and features needed to create the model. They must list the appropriate 3D modeling commands and solid editing operations they would use to create the model.</p>																		
5	<p>Rendering in AutoCAD</p> <p>Rendering concepts, Visual styles and rendering modes, Materials and material library, Material mapping and scaling, Lighting types and light setup, Sun and sky lighting, Cameras and viewpoints, Scene setup and background control, Shadows and reflections, Render presets and quality settings, Rendering of 3D solids and surfaces, Sectioned and transparent rendering, Rendered views in layouts, Plot and export rendered images.</p> <p>Practical:</p> <ol style="list-style-type: none"> 1) Introduction to Rendering Environment and Visual Styles 2) Application of Materials to 3D Objects 3) Material Mapping and Texture Scaling 4) Setting Up Point, Spot, and Distant Lights 5) Sun and Sky Lighting Configuration 6) Camera Creation and Viewpoint Control 7) Scene Setup with Background and Environment 8) Shadow and Reflection Control in Rendering 9) Rendering Using Preset and Custom Quality Settings <p>Evaluation Method:</p> <table border="1"> <thead> <tr> <th>Sr. No.</th> <th>Evaluation Methods</th> <th>SEE</th> <th>CCE</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Rendering of 3D Models using AutoCAD</td> <td>20</td> <td></td> </tr> <tr> <td>2</td> <td>Analyze Materials, Lighting, and Rendering Settings</td> <td></td> <td>10</td> </tr> <tr> <td></td> <td>Total</td> <td>20</td> <td>10</td> </tr> </tbody> </table> <p>Examination Style:</p>	Sr. No.	Evaluation Methods	SEE	CCE	1	Rendering of 3D Models using AutoCAD	20		2	Analyze Materials, Lighting, and Rendering Settings		10		Total	20	10	T: 06 P: 16	20%
Sr. No.	Evaluation Methods	SEE	CCE																
1	Rendering of 3D Models using AutoCAD	20																	
2	Analyze Materials, Lighting, and Rendering Settings		10																
	Total	20	10																



	<p>3D Model Rendering using AutoCAD (20 Marks) Students will be provided with a completed 3D solid or surface model. Using AutoCAD rendering tools, they are required to apply appropriate materials, lighting, and camera settings to generate a realistic rendered view. Students must configure visual styles, control shadows and reflections, and select suitable render quality settings. The final output should include a properly composed rendered image, plotted and exported in the specified format.</p> <p>Active Learning Activity of Unit 5</p> <p>Analyze Rendering Setup for 3D Model (10 marks) Students will be provided with a completed 3D solid model in AutoCAD. They are required to analyze the model and propose an appropriate rendering setup by identifying suitable materials, lighting types, camera views, and rendering settings. Students must list and justify the rendering commands and settings (materials, lights, visual styles, render presets, shadows, and reflections) required to generate a realistic rendered output of the given model.</p>	
--	---	--

Suggested Specification table with Marks:

Distribution of Theory Marks (Revised Bloom's Taxonomy)						
Level	Remembrance (R)	Understanding (U)	Application (A)	Analyze (N)	Evaluate (E)	Create (C)
Weightage %	10%	10%	30%	15%	10%	25%

Course Outcome:

After learning the course, the students should be able to:	
CO1	Understand basic concepts, types, and standards of mechanical drawings.
CO2	Implement basic 2D and 3D AutoCAD commands for drafting and modeling.
CO3	Create 2D views with proper dimensioning, annotations, and plotting using Auto CAD.
CO4	Develop 3D models from 2D drawings using Auto CAD, solid editing commands, and visual styles.
CO5	Apply rendering techniques to generate realistic visual outputs of 3D models and assemblies using CAD software.



Instructional Method:

The course delivery method will depend upon the requirement of content and the needs of students. The teacher, in addition to conventional teaching methods by black board, may also use any tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.

From the content 10% topics are suggested for flipped mode instruction.

Students will use supplementary resources such as online videos, NPTEL/SWAYAM videos, e-courses, Virtual Laboratory

The internal evaluation will be done on the basis of Active Learning Assignment.

Practical/Viva examination will be conducted at the end of semester for evaluation of performance of students in the laboratory.

Reference Books:

- [1] Machine drawing including AutoCAD, Ajeet Singh, McGraw-Hill
- [2] Textbook of Machine Drawing, R. K. Dhawan, S. Chand Publication
- [3] Engineering Graphics with AutoCAD, James D. Bethune, Pearson
- [4] Fundamentals of Machine Drawing, Sadhu Singh, Khanna Publishers
- [5] Technical Drawing with Engineering Graphics, Frederick E. Giesecke et al., Pearson Education

Suggested Rubrics:

Suggested Assessment Guidelines	
	Debugging Task: 1 <ul style="list-style-type: none">• 10 Marks: Identification and Correct use of dimensioning methods with proper layout• 05 Marks: Application of standard symbols & conventions• 05 Marks: Title block creation
	Debugging Task: 2 <ul style="list-style-type: none">• 03 Marks: Use of line, circle, arc, polyline, polygon• 03 Marks: Use of array command (circular or rectangular)• 03 Marks: Mirror and trim commands for symmetry/cleanup• 03 Marks: Chamfer and fillet for edge detailing• 03 Marks: Rotate, scale, extend for orientation adjustment• 03 Marks: Use of ortho, osnap, polar tracking for precision• 02 Marks: Application of move, copy, erase



3	Debugging Task: <ul style="list-style-type: none"> • 06 Marks: Accurate creation of 2D views • 03 Marks: Proper application of dimensions • 03 Marks: Use of dimension styles and layers • 03 Marks: Use of leader lines and engineering notes • 03 Marks: Drawing layout, plotting, and presentation • 02 Marks: Export drawing to PDF or any other format
4	Debugging Task: <ul style="list-style-type: none"> • 06 Marks: Creation of 3D model using primitives/commands • 04 Marks: Application of solid editing operations • 04 Marks: Use of navigation tools and visual styles • 04 Marks: Generation of 2D views from 3D model • 02 Marks: Plot and Export drawing with proper layout
5	Debugging Task: <ul style="list-style-type: none"> • 06 Marks: Apply appropriate materials and textures to 3D models • 04 Marks: Setup of lighting (point, spot, distant / sun & sky) • 04 Marks: Camera creation and view composition for rendering • 04 Marks: Control of shadows, reflections, and render quality settings • 02 Marks: Render, plot, and export final rendered image with proper layout

