

**3D MODELLING AND ADDITIVE MANUFACTURING****Course Code : 316013****Programme Name/s : Mechanical Engineering****Programme Code : ME****Semester : Sixth****Course Title : 3D MODELLING AND ADDITIVE MANUFACTURING****Course Code : 316013****I. RATIONALE**

Industry needs to build models-based applications which are being developed using solid modeling software. The 3D Modeling and Additive Manufacturing course equips diploma students with essential skills in designing and producing mechanical parts using 3D modeling and additive technologies.

**II. INDUSTRY / EMPLOYER EXPECTED OUTCOME**

The aim of this course is to help the students to attain the following industry outcome through various teaching learning experience: Apply skills to create, prototype and manufacturing of mechanical components using solid modeling and 3D printing techniques.

**III. COURSE LEVEL LEARNING OUTCOMES (COS)**

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Prepare 2D drawing using sketch toolbar of given 3D modeling software.
- CO2 - Prepare 3D solid models from 2D sketch using given 3D modeling software.
- CO3 - Prepare assembly of part models using given 3D modeling software.
- CO4 - Plot a drawing for given part model/ assembly.
- CO5 - Prepare components of assembly using 3D printer/ rapid prototyping machine.

**IV. TEACHING-LEARNING & ASSESSMENT SCHEME**

| Course Code | Course Title                            | Abbr | Course Category/s | Learning Scheme           |       |       |       |       | Credits | Assessment Scheme |           |     |     |                  |    |             |     |             |   |   |    |
|-------------|---|------|-------------------|---------------------------|-------|-------|-------|-------|---------|-------------------|-----------|-----|-----|------------------|----|-------------|-----|-------------|---|---|----|
|             |   |      |                   | Actual Contact Hrs./ Week |       |       | SLH   | NLH   |         | Paper Duration    | Theory    |     |     | Based on LL & TL |    | Based on SL |     | Total Marks |   |   |    |
|             |   |      |                   | CL                        | TL    | LL    |       |       |         |                   | Practical |     |     | SLA              |    |             |     |             |   |   |    |
|             |   |      |                   | FA-TH                     | SA-TH | Total | FA-PR | SA-PR |         |                   | Max       | Min | Max | Min              |    |             |     |             |   |   |    |
| Max         | Max                                     | Max  | Min               | Max                       | Min   | Max   | Min   | Max   | Min     |                   |           |     |     |                  |    |             |     |             |   |   |    |
| 316013      | 3D MODELLING AND ADDITIVE MANUFACTURING | 3DM  | SEC               | -                         | -     | 4     | -     | 4     | 2       | -                 | -         | -   | -   | -                | 25 | 10          | 25# | 10          | - | - | 50 |

**Total IKS Hrs for Sem. : 0 Hrs**

Abbreviations: CL- Classroom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, \*# On Line Examination , @\$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.\* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. \* Self learning hours shall not be reflected in the Time Table.
7. \* Self learning includes micro project / assignment / other activities.

**3D MODELLING AND ADDITIVE MANUFACTURING****Course Code : 316013****V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT**

| Sr.No | Theory Learning Outcomes (TLO's) aligned to CO's.   | Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.   | Suggested Learning Pedagogies.  |
|-------|---|---|---|
| 1     | TLO 1.1 Draw 2D sketch using sketch tool.<br>TLO 1.2 Draw template for 2D sketch.   | <b>Unit - I Working in 2D environment</b><br>1.1 Drawing tool: Line, Construction line, Rectangle, Polygon, Circle, Arc, Ellipse, Spline, etc.<br>1.2 Editing tool: Trim, Delete, Extend, Erase, Mirror, etc.<br>1.3 Modify tool: Chamfer, Fillet, Copy, Move, Pattern etc.<br>1.4 Linear, Angular dimensions, Dimensional constraint and Geometrical constraint.<br>1.5 Drawing template: Prepare drawing template consisting of name plate, boundary lines and projection symbol. | Lecture Using Chalk-Board<br>Presentations<br>Video<br>Demonstrations |
| 2     | TLO 2.1 Draw 3D models of given components.<br>TLO 2.2 Modify 3D models of given components.<br>TLO 2.3 Draw Auxiliary planes.  | <b>Unit - II Development of solid models</b><br>2.1 Working in 3D environment: Planes, creating 3D Solid Models of simple machine parts.<br>2.2 Part tool: Extrude, Hole, Revolve, Rib, Sweep, swept blend, Pattern, etc.<br>2.3 Part Modify tool: Chamfer, Round, Copy, Move, Draft, etc.<br>2.4 Creating parts using auxiliary plane.   | Demonstration<br>Video<br>Demonstrations                              |
| 3     | TLO 3.1 Assemble given 3D components.<br>TLO 3.2 Produce exploded view of given assembly drawing.   | <b>Unit - III Computer aided assembly</b><br>3.1 Assembly drawing: Preparation of assembly drawing by using assembly tool.<br>3.2 Relative degrees of freedom and constraints of assembly.<br>3.3 Rotational and translational motions of assembly, constraining motions.<br>3.4 Exploded view: Explode the assembly.   | Video<br>Demonstrations<br>Lecture Using Chalk-Board<br>Presentations |
| 4     | TLO 4.1 Generate production drawing from given assembly.<br>TLO 4.2 Prepare part list.<br>TLO 4.3 Setup printing parameters.<br>TLO 4.4 Plot production drawing.                        | <b>Unit - IV Plotting and drafting 3D assembly</b><br>4.1 Generate orthographic projection of assembly: Various views- Sectional, Auxiliary, Isometric Views, etc.<br>4.2 Bill of Materials : Prepare part lists, Name plate on sheet.<br>4.3 Printer selection, paper size, orientation.<br>4.4 Page set up and plotting drawing.  | Video<br>Demonstrations<br>Presentations<br>Lecture Using Chalk-Board |
| 5     | TLO 5.1 Select suitable material for part printing using 3D Printer in given situation.<br>TLO 5.2 Create slices in Slicer software.<br>TLO 5.3 Print given component using 3D printer. | <b>Unit - V Additive manufacturing</b><br>5.1 3D printing file formats.<br>5.2 Selection of material.<br>5.3 Printing parameter setting: Temperature, wall thickness, infill percentage, orientation, etc.<br>5.4 Need of supports, types of support.<br>5.5 Slicing layers using software.<br>5.6 Exporting and printing.  | Video<br>Demonstrations<br>Lecture Using Chalk-Board<br>Presentations |

**VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.**

| Practical / Tutorial / Laboratory Learning Outcome (LLO) | Sr No | Laboratory Experiment / Practical Titles / Tutorial Titles | Number of hrs. | Relevant COs |
|--|-------|--|----------------|--------------|
|  |       |  |                |              |

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| Practical / Tutorial / Laboratory Learning Outcome (LLO)   | Sr No | Laboratory Experiment / Practical Titles / Tutorial Titles   | Number of hrs. | Relevant COs             |
|--|-------|--|----------------|--------------------------|
| LLO 1.1 Use of sketch toolbar for drawing 2D entities.   | 1     | *Preparing drawing template consisting of name plate, boundary lines and projection symbols.   | 2              | CO1                      |
| LLO 2.1 Draw the simple 2D components from given part drawing.<br>LLO 2.2 Plot the given components drawing. | 2     | Drawing and plotting two simple 2D geometries using sketcher commands.   | 2              | CO1<br>CO4               |
| LLO 3.1 Draw the simple 3D components from given part drawing.<br>LLO 3.2 Plot the given components.         | 3     | *Drawing and plotting the given two simple 3-D drawings using 3D modeling commands.  | 4              | CO1<br>CO2<br>CO4        |
| LLO 4.1 Draw the complex 3D components from given part drawing.<br>LLO 4.2 Plot the given components.        | 4     | Drawing and plotting the given two complex 3D drawings using 3D modeling commands.   | 4              | CO1<br>CO2<br>CO4        |
| LLO 5.1 Develop 3D model of components from given part drawing.<br>LLO 5.2 Plot the given components.        | 5     | *Drawing and plotting the production drawing of the 3D part models of individual components of Bench vice/ Drill Jig/ Screw Jack/ Tool Post/ any assembly consisting of at least five parts.(Problem-I)            | 4              | CO1<br>CO2<br>CO4        |
| LLO 6.1 Develop 3D model of components from given part drawing.<br>LLO 6.2 Plot the given components.        | 6     | *Drawing and plotting the production drawing of the 3D part models of individual components of Bench vice/ Drill Jig/ Screw Jack/ Tool Post/ any assembly consisting of at least five parts. (Problem-I continued) | 4              | CO1<br>CO2<br>CO4        |
| LLO 7.1 Develop 3D model of components from given part drawing.<br>LLO 7.2 Plot the given components.        | 7     | *Drawing and plotting the production drawing of the 3D part models of individual components of Bench vice/ Drill Jig/ Screw Jack/ Tool Post/ any assembly consisting of at least five parts. (Problem-I continued) | 4              | CO1<br>CO2<br>CO4        |
| LLO 8.1 Develop 3D model of components from given part drawing.<br>LLO 8.2 Plot the given components.        | 8     | *Drawing and plotting the production drawing of the 3D part models of individual components of Bench vice/ Drill Jig/ Screw Jack/ Tool Post/ any assembly consisting of at least five parts. (Problem-I continued) | 4              | CO1<br>CO2<br>CO4        |
| LLO 9.1 Assemble the given 3D components from given part drawing.<br>LLO 9.2 Plot the given components.      | 9     | *Assembly and plotting the orthographic views of the assembly, bill of materials of Bench vice/ Drill Jig/ Screw Jack/ Tool Post/ any assembly consisting of at least five parts. (Problem-I)                      | 4              | CO1<br>CO2<br>CO3<br>CO4 |
| LLO 10.1 Develop 3D model of components from given part drawing.<br>LLO 10.2 Plot the given components.      | 10    | Drawing and plotting the production drawing of the 3D part models of individual components of Bench vice/ Drill Jig/ Screw Jack/ Tool Post/ any assembly consisting of at least five parts. (Problem-II)           | 4              | CO1<br>CO2<br>CO4        |
| LLO 11.1 Develop 3D model of components from given part drawing.<br>LLO 11.2 Plot the given components       | 11    | Drawing and plotting the production drawing of the 3D part models of individual components of Bench vice/ Drill Jig/ Screw Jack/ Tool Post/ any assembly consisting of at least five parts. (Problem-II continued) | 4              | CO1<br>CO2<br>CO4        |

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| <b>Practical / Tutorial / Laboratory Learning Outcome (LLO)</b>   | <b>Sr No</b> | <b>Laboratory Experiment / Practical Titles / Tutorial Titles</b>  | <b>Number of hrs.</b> | <b>Relevant COs</b>      |
|---|--------------|--|-----------------------|--------------------------|
| LLO 12.1 Develop 3D model of components from given part drawing. LLO 12.2 Plot the given components.  | 12           | Drawing and plotting the production drawing of the 3D part models of individual components of Bench vice/ Drill Jig/ Screw Jack/ Tool Post/ any assembly consisting of at least five parts. (Problem-II continued) | 4                     | CO1<br>CO2<br>CO4        |
| LLO 13.1 Develop 3D model of components from given part drawing. LLO 13.2 Plot the given components.  | 13           | Drawing and plotting the production drawing of the 3D part models of individual components of Bench vice/ Drill Jig/ Screw Jack/ Tool Post/ any assembly consisting of at least five parts. (Problem-II continued) | 4                     | CO1<br>CO2<br>CO4        |
| LLO 14.1 Assemble the given 3D components from given part drawing. LLO 14.2 Plot the given components.  | 14           | Assembly and plotting the orthographic views of the assembly, bill of materials of Bench vice/ Drill Jig/ Screw Jack/ Tool Post/ any assembly consisting of at least five parts. (Problem-II)                      | 4                     | CO1<br>CO2<br>CO3<br>CO4 |
| LLO 15.1 3D print the given component.  | 15           | *Printing any one component from above assembly using 3D printer/ Rapid prototyping machine.   | 8                     | CO5                      |
| <b>Note : Out of above suggestive LLOs -</b>  |              |  |                       |                          |
| <ul style="list-style-type: none"> <li>• *Marked Practicals (LLOs) Are mandatory.</li> <li>• Minimum 80% of above list of lab experiment are to be performed.</li> <li>• Judicial mix of LLOs are to be performed to achieve desired outcomes.</li> </ul> |              |  |                       |                          |

**VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING) : NOT APPLICABLE****VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED**

| <b>Sr.No</b> | <b>Equipment Name with Broad Specifications</b>  | <b>Relevant LLO Number</b>          |
|--------------|--|-------------------------------------|
| 1            | Workstation with latest configurations for each student, Microsoft Windows 10 or above, with minimum i5 Processor (2.5 GHz), 8 GB RAM, 512 SDD.            | 1,2,3,4,5,6,7,8,9,10,11,12,13,14,15 |
| 2            | LCD projector (at least 4500 lumens and aspect ratio 16:10)/ Screen/ Interactive board.  | 1,2,3,4,5,6,7,8,9,10,11,12,13,14,15 |
| 3            | Plotter: Multifunction Wide format plotter, Scanning Size A0-A4, Resolution 1200 X 1200/ Printer with latest versions (A3/A4 size) Laserjet.               | 1,2,3,4,6,7,8,9,10,11,12,13,14,15   |
| 4            | Free version/ Latest Educational version of 3-D modelling software such as CATIA, Solid Works, Creo, NX4, etc.   | 5                                   |
| 5            | 3D printer (FDM): size- 200 x 200 x 250 mm, layer resolution 0.08 mm to 0.4 mm, print speed 40-120 mm/sec, Nozzle size 0.4mm, Filament- ABS/PLA/Composite. | 5                                   |
| 6            | Software: 3D printing software (slicing software).   | 5                                   |
| 7            | Filament PLA, PETG, Nylon, ABS.  | 5                                   |

**IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table) : NOT APPLICABLE****X. ASSESSMENT METHODOLOGIES/TOOLS****Formative assessment (Assessment for Learning)**

- For laboratory learning 25 Marks

**3D MODELLING AND ADDITIVE MANUFACTURING****Course Code : 316013****Summative Assessment (Assessment of Learning)**

- End semester assessment of 25 marks for laboratory learning

**XI. SUGGESTED COS - POS MATRIX FORM**

| Course Outcomes (COs) | Programme Outcomes (POs)                     |                       |                                       |                        |  |                         |                         | Programme Specific Outcomes* (PSOs) |       |       |
|-----------------------|--|-----------------------|---------------------------------------|------------------------|--|-------------------------|-------------------------|-------------------------------------|-------|-------|
|                       | PO-1 Basic and Discipline Specific Knowledge | PO-2 Problem Analysis | PO-3 Design/ Development of Solutions | PO-4 Engineering Tools | PO-5 Engineering Practices for Society, Sustainability and Environment | PO-6 Project Management | PO-7 Life Long Learning | PSO-1                               | PSO-2 | PSO-3 |
| CO1                   | 3  | 1                     | 2                                     | 3                      | 1  | 2                       | 1                       |                                     |       |       |
| CO2                   | 3  | 1                     | 2                                     | 3                      | 1  | 2                       | 1                       |                                     |       |       |
| CO3                   | 3  | 1                     | 2                                     | 3                      | 1  | 2                       | 1                       |                                     |       |       |
| CO4                   | 3  | 1                     | 2                                     | 3                      | 1  | 2                       | 1                       |                                     |       |       |
| CO5                   | 3  | 1                     | 2                                     | 3                      | 2  | 2                       | 1                       |                                     |       |       |

Legends :- High:03, Medium:02,Low:01, No Mapping: -  
\*PSOs are to be formulated at institute level

**XII. SUGGESTED LEARNING MATERIALS / BOOKS**

| Sr.No | Author                    | Title                                       | Publisher with ISBN Number     |
|-------|---------------------------|---|--------------------------------|
| 1     | Sham Tickoo               | CATIA V5R20 for Designers                   | Softcover, Cadcim Technologies |
| 2     | Sham Tickoo               | Pro/ENGINEER Wildfire for Designers         | Softcover, Cadcim Technologies |
| 3     | Sham Tickoo               | Solid Works For Designers Release 2006      | Softcover, Cadcim Technologies |
| 4     | Sham Tickoo               | Autodesk Inventor for Designers: Release 10 | Softcover, Cadcim Technologies |
| 5     | Sham Tickoo, Deepak Maini | NX 4 for Designers                          | Softcover, Cadcim Technologies |
| 6     | Sham Tickoo, Deepak Maini | Solid Edge V19 for Designers                | Softcover, Cadcim Technologies |

**XIII. LEARNING WEBSITES & PORTALS**

| Sr.No | Link / Portal   | Description  |
|-------|---|--|
| 1     | <a href="https://archive.nptel.ac.in/courses/112/102/112102304/">https://archive.nptel.ac.in/courses/112/102/112102304/</a> | NPTEL: Engineering graphics and design   |
| 2     | <a href="https://www.3ds.com/store/cad/solid-modeling">https://www.3ds.com/store/cad/solid-modeling</a>                     | Dassault systems: What is solid modeling and why is it so essential to design? |
| 3     | <a href="https://en.wikipedia.org/wiki/Solid_modeling">https://en.wikipedia.org/wiki/Solid_modeling</a>                     | Solid modeling   |
| 4     | <a href="https://www.youtube.com/watch?v=vjX4PDJcFOI">https://www.youtube.com/watch?v=vjX4PDJcFOI</a>                       | Solid modeling   |
| 5     | <a href="https://www.youtube.com/watch?v=JjKs-lePIPY">https://www.youtube.com/watch?v=JjKs-lePIPY</a>                       | How to Read & Create 3d Models from 2d Drawings                                |

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| Sr.No  | Link / Portal | Description |
|--|---------------|-------------|
| <b>Note :</b>  |               |             |
| <ul style="list-style-type: none"><li>Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students</li></ul> |               |             |

MSBTE Approval Dt. 04/09/2025

Semester - 6, K Scheme