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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
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											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

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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.

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. TLO 1.2 Draw template for 2D sketch.	**Unit - I Working in 2D environment** 1.1 Drawing tool: Line, Construction line, Rectangle, Polygon, Circle, Arc, Ellipse, Spline, etc. 1.2 Editing tool: Trim, Delete, Extend, Erase, Mirror, etc. 1.3 Modify tool: Chamfer, Fillet, Copy, Move, Pattern etc. 1.4 Linear, Angular dimensions, Dimensional constraint and Geometrical constraint. 1.5 Drawing template: Prepare drawing template consisting of name plate, boundary lines and projection symbol.	Lecture Using Chalk-Board Presentations Video Demonstrations
2	TLO 2.1 Draw 3D models of given components. TLO 2.2 Modify 3D models of given components. TLO 2.3 Draw Auxiliary planes.	**Unit - II Development of solid models** 2.1 Working in 3D environment: Planes, creating 3D Solid Models of simple machine parts. 2.2 Part tool: Extrude, Hole, Revolve, Rib, Sweep, swept blend, Pattern, etc. 2.3 Part Modify tool: Chamfer, Round, Copy, Move, Draft, etc. 2.4 Creating parts using auxiliary plane.	Demonstration Video Demonstrations
3	TLO 3.1 Assemble given 3D components. TLO 3.2 Produce exploded view of given assembly drawing.	**Unit - III Computer aided assembly** 3.1 Assembly drawing: Preparation of assembly drawing by using assembly tool. 3.2 Relative degrees of freedom and constraints of assembly. 3.3 Rotational and translational motions of assembly, constraining motions. 3.4 Exploded view: Explode the assembly.	Video Demonstrations Lecture Using Chalk-Board Presentations

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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.
4	TLO 4.1 Generate production drawing from given assembly. TLO 4.2 Prepare part list. TLO 4.3 Setup printing parameters. TLO 4.4 Plot production drawing.	**Unit - IV Plotting and drafting 3D assembly** 4.1 Generate orthographic projection of assembly: Various views- Sectional, Auxiliary, Isometric Views, etc. 4.2 Bill of Materials : Prepare part lists, Name plate on sheet. 4.3 Printer selection, paper size, orientation. 4.4 Page set up and plotting drawing.	Video Demonstrations Presentations Lecture Using Chalk-Board
5	TLO 5.1 Select suitable material for part printing using 3D Printer in given situation. TLO 5.2 Create slices in Slicer software. TLO 5.3 Print given component using 3D printer.	**Unit - V Additive manufacturing** 5.1 3D printing file formats. 5.2 Selection of material. 5.3 Printing parameter setting: Temperature, wall thickness, infill percentage, orientation, etc. 5.4 Need of supports, types of support. 5.5 Slicing layers using software. 5.6 Exporting and printing.	Video Demonstrations Lecture Using Chalk-Board 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
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. LLO 2.2 Plot the given components drawing.	2	Drawing and plotting two simple 2D geometries using sketcher commands.	2	CO1 CO4
LLO 3.1 Draw the simple 3D components from given part drawing. LLO 3.2 Plot the given components.	3	*Drawing and plotting the given two simple 3-D drawings using 3D modeling commands.	4	CO1 CO2 CO4
LLO 4.1 Draw the complex 3D components from given part drawing. LLO 4.2 Plot the given components.	4	Drawing and plotting the given two complex 3D drawings using 3D modeling commands.	4	CO1 CO2 CO4
LLO 5.1 Develop 3D model of components from given part drawing. 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 CO2 CO4

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 6.1 Develop 3D model of components from given part drawing. 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 CO2 CO4
LLO 7.1 Develop 3D model of components from given part drawing. 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 CO2 CO4
LLO 8.1 Develop 3D model of components from given part drawing. 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 CO2 CO4
LLO 9.1 Assemble the given 3D components from given part drawing. 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 CO2 CO3 CO4
LLO 10.1 Develop 3D model of components from given part drawing. 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 CO2 CO4
LLO 11.1 Develop 3D model of components from given part drawing. 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 CO2 CO4
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 CO2 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 CO2 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 CO2 CO3 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

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

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING) : NOT APPLICABLE

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
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

Summative Assessment (Assessment of Learning)

- End semester assessment of 25 marks for laboratory learning

XI. SUGGESTED COS - POS MATRIX FORM

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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	https://archive.nptel.ac.in/courses/112/102/112102304/	NPTEL: Engineering graphics and design
2	https://www.3ds.com/store/cad/solid-modeling	Dassault systems: What is solid modeling and why is it so essential to design?
3	https://en.wikipedia.org/wiki/Solid_modeling	Solid modeling
4	https://www.youtube.com/watch?v=vjX4PDJcFOI	Solid modeling
5	https://www.youtube.com/watch?v=JjKs-lePlPY	How to Read & Create 3d Models from 2d Drawings

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

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MSBTE Approval Dt. 04/09/2025 **Semester - 6, K Scheme**