

SOLID MODELLING AND ADDITIVE MANUFACTURING**Course Code : 316010**

Programme Name/s : Automobile Engineering.
Programme Code : AE
Semester : Sixth
Course Title : SOLID MODELLING AND ADDITIVE MANUFACTURING
Course Code : 316010

I. RATIONALE

The Solid Modeling and Additive Manufacturing course is designed to equip students of diploma in the automobile and allied Industries with essential skills in solid modeling techniques and additive manufacturing technologies. This course will empower students to apply solid modeling and additive manufacturing concepts and methodologies in the design, development, and production of mechanical parts.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help the students to attain the following industry identified outcome through various teaching learning experiences: Apply skills to create, prototype, and manufacture automobile components using solid modeling and additive manufacturing 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 - Print 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												Total Marks
				Actual Contact Hrs./Week	SLHNLH			Paper Duration		Theory				Based on LL & TL				Based on SL				
														Practical								
										CL	TL	LL	FA-TH	SA-TH	Total	FA-PR		SA-PR		SLA		
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min													
316010	SOLID MODELLING AND ADDITIVE MANUFACTURING	SAM	SEC	-	-	4	2	6	3	-	-	-	-	-	25	10	25#	10	25	10	75	

Total IKS Hrs for Sem. : 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 Drawing 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. Dimensioning constraint and Geometrical constraint. 1.5 Drawing template: prepare drawing template consisting of Name plate boundary lines and projection symbol.	Presentations Video Demonstrations Hands-on
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.	Presentations Video Demonstrations Hands-on
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.	Presentations Video Demonstrations Hands-on Site/Industry Visit

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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 Projections – Generate various views- Sectional, Auxiliary and Isometric Views. 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.	Presentations Video Demonstrations Hands-on
5	TLO 5.1 Select suitable material for printing part using 3D printer. 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	Presentations Video Demonstrations Hands-on Site/Industry Visit

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	*Setting drawing template consisting of Name plate boundary lines and projection symbol.	4	CO1
LLO 2.1 Draw given simple 2D components. LLO 2.2 Plot given components.	2	*Drawing and plotting two given simple 2D geometries using sketcher commands.	4	CO1 CO4
LLO 3.1 Draw given simple 3D components. LLO 3.2 Plot 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 given complex 3D components. LLO 4.2 Plot given components.	4	Drawing and plotting the given two Complex 3-D drawings using 3D modeling commands.	4	CO1 CO2 CO4
LLO 5.1 Develop 3D model of given components. LLO 5.2 Plot given components	5	*Drawing and plotting of the 05 identified individual components of assembly drawing of the 3D part models. (e.g. Bench vice/ Drill Jig/ Screw Jack /Tool Post / Piston-cylinder-connecting rod / Cam-shaft / hydraulic brake / or 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 given components. LLO 6.2 Plot given components.	6	*Drawing and plotting of the 05 identified individual components of assembly drawing of the 3D part models. (e.g. Bench vice/ Drill Jig/ Screw Jack /Tool Post / Piston-cylinder-connecting rod / Cam-shaft / hydraulic brake / or any assembly consisting of at least five parts.) (Problem-I continued for identified part)	4	CO1 CO2 CO4
LLO 7.1 Develop 3D model of given components. LLO 7.2 Plot given components	7	*Drawing and plotting of the 05 identified individual components of assembly drawing of the 3D part models. (e.g. Bench vice/ Drill Jig/ Screw Jack /Tool Post / Piston-cylinder-connecting rod / Cam-shaft / hydraulic brake / or any assembly consisting of at least five parts.) (Problem-I continued for identified part)	4	CO1 CO2 CO4
LLO 8.1 Develop 3D model of given components. LLO 8.2 Plot given components.	8	*Drawing and plotting of the 05 identified individual components of assembly drawing of the 3D part models. (e.g. Bench vice/ Drill Jig/ Screw Jack /Tool Post / Piston-cylinder-connecting rod / Cam-shaft / hydraulic brake / or any assembly consisting of at least five parts.) (Problem-I continued for identified part)	4	CO1 CO2 CO4
LLO 9.1 Assemble given 3D components. LLO 9.2 Plot given components.	9	*Assembly of the parts of identified assembly. Creating the orthographic views and bill of materials for the given assembly. (e.g. Bench vice/ Drill Jig/ Screw Jack /Tool Post / Piston-cylinder-connecting rod / Cam-shaft / hydraulic brake / or any assembly consisting of at least five parts.) (Problem-I continued for identified assembly)	4	CO1 CO2 CO3 CO4
LLO 10.1 Develop 3D model of given components. LLO 10.2 Plot given components.	10	Drawing and plotting of the 05 identified individual components of assembly drawing of the 3D part models. (e.g. Bench vice/ Drill Jig/ Screw Jack /Tool Post / Piston-cylinder-connecting rod / Cam-shaft / hydraulic brake / or any assembly consisting of at least five parts.) (Problem-II)	4	CO1 CO2 CO4
LLO 11.1 Develop 3D model of given components. LLO 11.2 Plot given components.	11	Drawing and plotting of the 05 identified individual components of assembly drawing of the 3D part models. (e.g. Bench vice/ Drill Jig/ Screw Jack /Tool Post / Piston-cylinder-connecting rod / Cam-shaft / hydraulic brake / or any assembly consisting of at least five parts.) (Problem-II continued for identified part)	4	CO1 CO2 CO4
LLO 12.1 Develop 3D model of given components. LLO 12.2 Plot given components.	12	Drawing and plotting of the 05 identified individual components of assembly drawing of the 3D part models. (e.g. Bench vice/ Drill Jig/ Screw Jack /Tool Post / Piston-cylinder-connecting rod / Cam-shaft / hydraulic brake / or any assembly consisting of at least five parts.) (Problem-II continued for identified part)	4	CO1 CO2 CO4
LLO 13.1 Develop 3D model of given components. LLO 13.2 Plot given components.	13	Drawing and plotting of the 05 identified individual components of assembly drawing of the 3D part models. (e.g. Bench vice/ Drill Jig/ Screw Jack /Tool Post / Piston-cylinder-connecting rod / Cam-shaft / hydraulic brake / or any assembly consisting of at least five parts.) (Problem-II continued for identified part)	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 14.1 Assemble given 3D components. LLO 14.2 Plot given components.	14	Assembly of the of the parts of identified assembly. Creating the orthographic views and bill of materials for the given assembly. (e.g. Bench vice/ Drill Jig/ Screw Jack /Tool Post / Piston-cylinder-connecting rod / Cam-shaft / hydraulic brake / or any assembly consisting of at least five parts.) (Problem-II continued for identified assembly)	4	CO1 CO2 CO3 CO4
LLO 15.1 Print the given component using 3D printer.	15	*Printing of any one component from above assembly using 3D printer/ Rapid prototyping machine.	4	CO5
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)**Micro project**

- A suggestive list of micro-projects are given here. Similar micro-projects could be added by the concerned faculty:
- 3D model: Each student will identify a small assembly from the institute workshop/laboratory. Measure the dimensions of each part and prepare sketches. Using sketches prepared 3D model of parts and assembly. Plot the assembly and detail drawings. (e.g. Piston-cylinder-connecting rod assembly, Cam-shaft assembly, Gear-train, Brake assembly, Bench vice, Machine vice, Tool post, Couplings, Joints, Bearings etc.)
- 3D printing/RPT: Each student will visits a nearby institute/industry. Collect information regarding troubleshooting of 3D printer/Rapid prototyping machine and prepare a report

Assignment

- Write a Brief Introduction to 3D Modelling with key features, advantages, and typical applications.
- Draw and plot simple 2D geometries using sketcher commands.
- Draw and plot the simple 3-D drawings using 3D modeling commands.
- Write a Brief Introduction to additives manufacturing with main characteristics, advantages over conventional methods, and specific applications.

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicious mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	3 D printer (FDM)- size- 200x200x250 mm, layer resolution 0.08 mm to 0.4 mm, print speed 40-120 mm/sec, Nozzle size 0.4mm,Filament-ABS/PLA/Composite	15
2	Software: 3D printing software (slicing software).	15
3	Filament PLA, PETG, Nylon, ABS	15
4	Plotter: Multifunction Wide format plotter size A0-A4, resolution 1200X1200 / Printer with latest versions (A3/A4 size) Laserjet	2,1,3,4,5,6,7,8,9,10,11,12,13,14
5	Workstation with latest configurations for each student. Microsoft Windows 10 or above, with minimum i5 Processor (2.5 GHz), 8 GB RAM, 512 SDD	All
6	Any free version of 3D modeling software / Academic version of 3-D modelling commercial software. (CATIA, Solid Works, Creo, NX4, Solid Edge, Delcam, Autocad etc.)	All
7	LCD projector with at least 4500 lumens and aspect ratio 16:10. OR Screen/ Interactive board.	All

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

- Continuous assessment based on process and product related performance indicators. Each practical will be assessed considering 1) 60% weightage is to process 2) 40% weightage to product

Summative Assessment (Assessment of Learning)

- Practical Exam of 25 Marks

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 V5R17 for Designers	Softcover, Cadcam Technologies
2	Sham Tickoo	Pro/ENGINEER Wildfire for Designers	Softcover, Cadcam Technologies
3	Sham Tickoo	Solid Works For Designers Release 2006	Softcover, Cadcam Technologies
4	Sham Tickoo	Autodesk Inventor for Designers: Release 10	Softcover, Cadcam Technologies
5	Sham Tickoo, Deepak Maini	NX 4 for Designers	Softcover, Cadcam Technologies
6	Sham Tickoo, Deepak Maini	Solid Edge V19 for Designers	Softcover, Cadcam Technologies
7	R.B. Patil, G. J. PAGAR, SATISH MANIAR	Solid Modeling and Drafting	TechKnowledge Publications, Pune

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://youtu.be/5DxUK-n16sg?si=BU9HGgRC3jcfaChY	Screw Jack Assembly Design
4	https://www.youtube.com/watch?v=vjX4PDJcFOI	Solid modeling
5	https://www.youtube.com/watch?v=JjKs-lePIPY	How to Read & Create 3d Models from 2d Drawings
6	https://archive.nptel.ac.in/courses/112/103/112103306/	NPTEL: Fundamentals of additive manufacturing Technologies
7	https://youtu.be/iM2qhc-cmV4?si=57xSDJX_yfROg4rb	Assembly Introduction Types Catia V5.

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Sr.No	Link / Portal	Description
8	https://youtu.be/f94CnlQ0eq4?si=EuDF4ehMaphCH88M	How does a 3D Printer work?
Note : Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students		

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