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SOLID MODELLING AND ADDITIVE MANUFACTURING **Course Code : 316012**

Programme Name/s : **Production Engineering**

Programme Code : **PG**

Semester : **Sixth**

Course Title : **SOLID MODELLING AND ADDITIVE MANUFACTURING**

Course Code : **316012**

I. RATIONALE

The addition of Solid Modeling and Additive Manufacturing (AM) into a Diploma in Production Engineering program is essential for ensuring that students have the skills and knowledge required to succeed in the rapidly changing manufacturing industry. These technologies have transformed traditional manufacturing processes, providing major improvements in flexibility of design and productivity.

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: Create prototype product using solid modeling and 3D printing technologies.

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 sketcher workbench of parametric CAD software.
- CO2 - Generate 3D Solid models from 2D sketch using Part workbench of parametric CAD software.
- CO3 - Plot a drawing for given part model/assembly.
- CO4 - Select relevant process and material for additive manufacturing.
- CO5 - Prepare components 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			SLH	NLH		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	
316012	SOLID MODELLING AND ADDITIVE MANUFACTURING	SMM	SEC	2	-	4	-	6	3	-	-	-	-	-	50	20	50#	20	-	-	100

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 Prepare 2D drawing using relevant tools with dimensioning and constraints.	**Unit - I Working in 2D environment** 1.1 Drawing tool: Line, Rectangle, Circle, Arc, Ellipse, Spline, etc. 1.2 Editing tool: Trim, Extend, Erase, Mirror, etc. 1.3 Modify tool: Chamfer, Fillet, Copy, Move, etc. 1.4 Linear, angular dimensions. 1.5 Dimensioning constraint and Geometrical constraint. 1.6 Drawing template: prepare drawing template consisting of Name plate boundary lines and projection symbol.	Lecture Using Chalk-Board Video Demonstrations
2	TLO 2.1 Interprete the given 3D part and assembly using different commands with minimum specification tree. TLO 2.2 Identify the different tools to be used for given 3D part model / assembly.	**Unit - II Development of solid models** 2.1 Working in 3D environment: Creating 3D Solid Models of simple machine parts. 2.2 Part tool: Extrude, Hole, Revolve, Rib, Sweep, Swept blend, Pattern, etc. 2.3 Part Editing tool: Trim, Extend, Erase, Mirror, 2.4 Part Modify tool: Chamfer, Round, Copy, Move, Draft, etc. 2.5 Intersect 2 solid components by inserting new body option. Boolean operations: Union, subtract, intersection.	Lecture Using Chalk-Board Video Demonstrations
3	TLO 3.1 Set the plotting parameters and plot the given specified output.	**Unit - III Plotting** 3.1 Printer selection, paper size, orientation. 3.2 Page set up	Lecture Using Chalk-Board Video Demonstrations
4	TLO 4.1 Explain the concept of Additive Manufacturing TLO 4.2 Explain the salient features of Additive Manufacturing processes with justification. TLO 4.3 Explain the FDM process cycle. . TLO 4.4 Select relevant material in the FDM printing process TLO 4.5 Explain working of the FDM 3D printer and its Parts.	**Unit - IV Introduction to Additive Manufacturing** 4.1 Definition and the concept of Additive Manufacturing 4.2 Differences between AM and traditional manufacturing, advantages and limitations. 4.3 Types of Additive Manufacturing Technologies: Stereolithography (SLA), Selective Laser Sintering (SLS), Fused Deposition Modeling (FDM), Digital Light Processing (DLP), Electron Beam Melting (EBM), Laminated Object Manufacturing (LOM). Applications, advantages and limitations 4.4 Introduction to 3D Scanner 4.5 Introduction to the FDM Process 4.6 Generic FDM Process cycle. 4.7 Materials for FDM Process PLA, PETG, Nylon, ABS etc. Applications, advantages and limitations. 4.8 Working of FDM 3D printer and its Parts- Nozzle, Print Bed, Belts, Motors etc.	Lecture Using Chalk-Board Video Demonstrations
5	TLO 5.1 Select printing parameters for creating 3D parts. TLO 5.2 Interprete post processing operations on 3D printed parts.	**Unit - V Software and Post processing** 5.1 Overview of Printing Software (Slicer). 5.2 Basic printing process parameters: Layer Height, Shell thickness, Infill Density, Infill Pattern etc. 5.3 Post processing: Support removal and Surface Finishing, Painting etc.	Lecture Using Chalk-Board Video Demonstrations

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

Practical / Tutorial /	Sr	Laboratory Experiment / Practical Titles / Tutorial Titles	Number	Relevant

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Laboratory Learning Outcome (LLO)	No		of hrs.	COs
LLO 1.1 Use of sketch toolbar to create nameplate.	1	*Drawing of template consisting of Name plate boundary lines and projection symbol.	2	CO1 CO3
LLO 2.1 Draw given simple 2D components.	2	*Drawing and plotting two simple 2D geometries using sketcher commands.	2	CO1 CO3
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 CO3
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 CO3
LLO 5.1 Develop 3D model of given components. LLO 5.2 Plot 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 or any assembly consisting of at least five parts. (Problem-I)	4	CO1 CO2 CO3
LLO 6.1 Develop 3D model of given components. LLO 6.2 Plot 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 or any assembly consisting of at least five parts. (Problem -I continued)	4	CO1 CO2 CO3
LLO 7.1 Develop 3D model of given components. LLO 7.2 Plot 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 or any assembly consisting of at least five parts. (Problem -I continued)	4	CO1 CO2 CO3
LLO 8.1 Develop 3D model of given components. LLO 8.2 Plot given components.	8	Drawing and plotting the production drawing of the 3D part models of individual components of Bench vice I Drill Jig/ Screw Jack/ Tool Post I any assembly consisting of at least five parts. (Problem -I continued)	4	CO1 CO2 CO3
LLO 9.1 Assemble given 3D components. LLO 9.2 Plot given components.	9	*Assembly of different parts and plotting of orthographic views of an assembly , bill of materials of Bench vice/ Drill Jig/ Screw Jack/ Tool Post or any assembly consisting of at least five parts. (Problem - I)	4	CO1 CO2 CO3
LLO 10.1 Develop 3D model of given components. LLO 10.2 Plot 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 or any assembly consisting of at least five parts. (Problem - II)	4	CO1 CO2 CO3
LLO 11.1 Develop 3D model of given components. LLO 11.2 Plot 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 or any assembly consisting of at least five parts. (Problem - II continued)	4	CO1 CO2 CO3
LLO 12.1 Develop 3D model of given components. LLO 12.2 Plot 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 or any assembly consisting of at least five parts. (Problem – II continued)	4	CO1 CO2 CO3
LLO 13.1 Develop 3D model of given	13	Drawing and plotting the production drawing of the 3D part models of individual components of Bench vice/ Drill Jig/	4	CO1 CO2

components. LLO 13.2 Plot given components.		Screw Jack/ Tool Post or any assembly consisting of at least five parts. (Problem – II continued)		CO3
LLO 14.1 Assemble given 3D components. LLO 14.2 Plot given components.	14	*Assembly of different parts and plotting of orthographic views of an assembly, bill of materials of Bench vice/ Drill Jig/ Screw Jack/ Tool Post/ and assembly consisting of at least five parts. (Problem - II)	4	CO1 CO2 CO3
LLO 15.1 3D print the given component.	15	*Printing any one component from above assembly using 3D printer/ Rapid prototyping machine.	8	CO4 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) : NOT APPLICABLE

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Plotter/Printer with latest versions (A3/A4 size)	1,2,3,4,5,6,7,8,9,10,11,12,13,14
2	Filament PLA, PETG, Nylon, ABS	15
3	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
4	Free 3D printing software (slicing software) such as Creality etc.	15
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	Free version/Latest education version of 3-D modelling software such as CATIA, Solid Works, Creo, UG-NX, etc.	All

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Working in 2D environment	CO1	4	0	0	0	0
2	II	Development of solid models	CO2	4	0	0	0	0
3	III	Plotting	CO3	2	0	0	0	0
4	IV	Introduction to Additive Manufacturing	CO4	14	0	0	0	0
5	V	Software and Post processing	CO5	6	0	0	0	0
Grand Total				**30**	**0**	**0**	**0**	**0**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Term work Each practical will be assessed considering 60% weightage to process and 40% weightage to product. Continuous assessment based on process and product related performance indicators, laboratory experience.

Summative Assessment (Assessment of Learning)

- Practical Exam of 50 marks

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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	2	1	1	3	-	1	2			
CO2	2	1	1	3	-	1	2			
CO3	2	1	1	3	-	1	2			
CO4	3	1	1	3	-	1	2			
CO5	3	1	1	3	-	1	2			

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 V5-6R2023 for Designers	CADCIM Technologies, 21 st Edition 2024,ISBN:-978-1640572409.
2	Sham Tickoo	SOLIDWORKS 2023 for Designers	CADCIM Technologies, USA, 21st edition, 2024, ISBN:-978-1-64057-172-3
3	Sham Tickoo	Solid Edge ST10 for Designers	BPB,15 th Edition, 2018, ISBN:-978-9387284104.
4	Tyler Kerr	3D Printing Introduction to Accessible, Affordable Desktop 3D Printing	Springer Cham, First addition 2022, ISBN978-3-031-19352-1
5	Sheku Kamara, Kathy S. Faggiani	Fundamentals of Additive Manufacturing for the Practitioner	Wiley, First addition 2021, ISBN:-978-1-119-75038-3
6	Ben Redwood, Mr.Filemon Schoffer, Mr.Brian Garret.	The 3D Printing Handbook: Technologies, design and applications	3D Hubs, First Edition, 2017, ISBN:-978-9082748505
7	Ian Gibson, David W. Rosen, Brent Stucker.	Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing	Springer, 2nd Edition, 2014, ISBN:-978-1493921133
8	Gary C. Confalone, John Smits, Thomas Kinnare	3D Scanning for Advanced Manufacturing, Design, and Construction	Wiley, First addition,2023 ISBN: 978-1-119-75851-8

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.youtube.com/watch?v=vjX4PDJcFOI	NPTEL Lecture on Solid Modeling
2	https://www.youtube.com/watch?v=t7yv4gSnNkE	Fundamentals of Additive Manufacturing Technologies
3	https://www.youtube.com/watch?v=9JTRqfNAqhM	Introduction to Additive Manufacturing
4	https://www.youtube.com/watch?v=htMr1oFE7Zg	CAD Models for Additive Manufacturing
5	https://oercommons.org/courseware/lesson/76708/overview	Open learning resource on Additive Manufacturing (AM)
6	https://www.youtube.com/watch?v=KhL3lHNqqsM	SolidWorks Basic

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Sr.No	Link / Portal	Description

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**