CHEMICAL ENGINEERING DRAWING & DESIGN **Course Code : 316302**

Programme Name/s : **Chemical Engineering**
Programme Code : **CH**
Semester : **Sixth**
Course Title : **CHEMICAL ENGINEERING DRAWING & DESIGN**
Course Code : **316302**

I. RATIONALE

Diploma in chemical engineering requires knowledge of various chemical equipment, their details and assembly. The course contains drawings of various equipment like heat exchangers, reactors, storage vessels, their supports etc., block diagram, process flow sheets, utility line diagrams, instrumentation diagrams, equipment layout, tank layout. Since drawings are the language of engineers, diploma chemical engineers will be able to express their thoughts and ideas to arrange various equipment in a specific pattern as per the process requirement and prepare their drawings using CAD software. This course also covers the basics of chemical engineering equipment design with the example of storage tanks.

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 theoretical knowledge and practical skills to create accurate, detailed, and standardized engineering drawings of chemical equipment and processes, including process flow diagrams, P&ID, equipment layout and equipment designs.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Draw different shapes using CAD software by drawing, editing and formatting.
- CO2 - Draw different flanges, support for pipe and vessel in chemical industries.
- CO3 - Draw heat exchanger, reactors and their assembly used in chemical industries.
- CO4 - Draw various flow diagram for different processes by using symbols and specification sheet in chemical industries.
- CO5 - Describe the design procedure of chemical equipment and design of storage tank.

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		
316302	CHEMICAL ENGINEERING DRAWING & DESIGN	CEDD	DSC	4	-	4	-	8	4	04	30	70	100	40	25	10	-	-	-	-	125	

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 Explain the use of Computer Aided Drafting (CAD) software in the given chemical engineering application. TLO 1.2 Explain the use CAD software for the specified workspace and interface. TLO 1.3 Use relevant drawing command for the given assignment and Identify Grips editing commands. TLO 1.4 Select relevant modify commands and procedure to use those in the given situation. TLO 1.5 State the relevant formatting commands in the given situation.	**Unit - I Computer Aided Drafting Software** 1.1 Fundamentals of Computer Aided Drafting (CAD) and its applications in chemical industries. 1.2 CAD initial setting commands- Snap, grid, ortho, osnap, limits, units, ltscale, object tracking. 1.3 Drawing command and procedure: Line, arc, circle, rectangle. 1.4 Modify command and procedure - Break, trim, copy, move, stretch. 1.5 Formatting commands - Layers, block, linetype, lineweight, colour.	Lecture Using Chalk-Board Presentations Hands-on computer

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.
2	TLO 2.1 Sketch the flange for the given application. TLO 2.2 Draw proportionate sketch of supports for pipe in chemical process industry. TLO 2.3 Draw neat and proportionate sketch of supports for the given vessels.	**Unit - II Flanges, Support for Pipe and Vessel** 2.1 Types of Flanges (drawing only): Flange cast with pipe (Integral Flange), slip on flange, welded neck flange, screwed flange, blind flange, cast iron flange joint. 2.2 Pipe Support (drawing only): Single rod hanger, double rod hanger, angle iron hanger, structural bracket and hanger, roller support, yard piping support. 2.3 Vessels Support (drawing only): a. Vertical vessel supports: Bracket or lug support, leg support, skirt (angular and straight) support. b. Horizontal vessel supports: Saddle (plate and ring type) support wear plate support.	Lecture Using Chalk-Board Presentations Video Demonstrations
3	TLO 3.1 Draw different type of heat exchanger. TLO 3.2 Draw different type of heat exchanger assembly. TLO 3.3 Draw different type of process reactor. TLO 3.4 Draw different type of process reactor assembly.	**Unit - III Process Equipment Drawing** 3.1 Heat exchanger (drawing only): a. Shell and tube heat exchanger b. U-tube heat exchanger c. Kettle type reboiler. 3.2 Heat exchanger assembly (drawing only): Tube sheet- Triangular and square pitch, method of fixing tube sheet, segmental baffle and tie rod, shell and tube side passes. 3.3 Process reactor (drawing only): Batch reactor, jacketed batch reactor. 3.4 Assembly of process reactor (drawing only): Different types of nozzles, jackets, coils, agitators and heads/covers.	Lecture Using Chalk-Board Presentations Video Demonstrations
4	TLO 4.1 Draw the given unit operation equipment and instrumentation symbols. TLO 4.2 Prepare specification sheet for the given process equipment. TLO 4.3 Draw the block diagram of the given process. TLO 4.4 Draw utility and engineering line diagram for the given process. TLO 4.5 Draw process and instrumentation diagram for the given process. TLO 4.6 Draw equipment layout and tank farm of the given process.	**Unit - IV Specification Sheet and Process Flow Diagrams** 4.1 Symbols for unit operation equipment's, instrumentation as per IS 3232. 4.2 Specification sheet for equipment's - Heat exchanger, batch reactor. 4.3 Draw the block diagram, process flow diagram, process and instrumentation diagram, utility line diagram, equipment layout, tank farm layout for the following processes Absolute alcohol, Ortho nitro aniline (ONA) and Oxalic acid.	Lecture Using Chalk-Board Presentations Video Demonstrations

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.
5	TLO 5.1 Describe general design procedure for chemical process equipment. TLO 5.2 State classification of storage tank for design. TLO 5.3 Design of storage tank shell subjected to internal pressure.	**Unit - V Basics of Chemical Engineering Design** 5.1 Basic considerations in process equipment design: Introduction, general design procedure, choice of material, corrosion allowance. 5.2 Storage tank: Introduction, storage of non-volatile liquids, storage of volatile liquids, standard fixed roof of storage tank. 5.3 Design of storage tanks: Types of tanks for design purpose, bottom design. Shell design: Internal loading, external loading, shell thickness. (Numerical based on maximum stress of bottom design, shell thickness).	Lecture Using Chalk-Board Presentations Video Demonstrations

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 Draw basic shapes using CAD software by selecting the appropriate object from the draw menu or draw toolbar.	1	Draw a line, square, rectangle, hexagon and circle using CAD software by choosing an object either from the draw menu or draw tool bar.	4	CO1
LLO 2.1 Draw an arc by specifying three points using CAD software, selecting the appropriate object from the draw menu or draw toolbar.	2	* Draw an arc by specifying three point using CAD software by choosing an object either from the draw menu or draw tool bar.	4	CO1
LLO 3.1 Draw flowsheet symbols using CAD software.	3	Draw flowsheet symbol in CAD software for packed column, heat exchanger, agitator and centrifuge.	4	CO1
LLO 4.1 Sketch and explain the accurate schematic view of various flanges.	4	Draw schematic view of slip on flanges, Welded neck flanges, screwed flanges, blind flanges on drawing sheet.	4	CO2
LLO 5.1 Sketch and describe the accurate drawings of various pipe support.	5	* Draw Pipe Support: Single rod hanger, double rod hanger, angle iron hanger, structural bracket and hanger, roller support, yard piping support on drawing sheet.	4	CO2
LLO 6.1 Sketch and explain accurate drawings of various vessels support.	6	* Draw vessels support: Vertical vessel supports, Bracket or lug support, Leg support, Skirt (Angular and Straight) support on drawing sheet.	4	CO2
LLO 7.1 Sketch and describe the accurate drawings of various vessels support.	7	Draw vessels support: Horizontal vessel supports, Saddle (Plate and Ring type) support, Wear plate support.	4	CO2
LLO 8.1 Sketch and describe the ability to create accurate drawings of heat exchanger.	8	* Draw shell and tube heat exchanger, U-tube heat exchanger and Kettle type reboiler on drawing sheet.	4	CO3

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 9.1 Sketch the accurate drawings of heat exchanger assembly.	9	Draw heat exchanger assembly like tube sheet- Triangular and square pitch, Method of fixing tube sheet, segmental baffle and tie rod, shell and tube side passes.	4	CO3
LLO 10.1 Sketch and explain accurate drawings of reactors and its assembly.	10	* Draw batch reactor, jacketed batch reactor and assembly of process reactor like different types of nozzles, jackets, coils, agitators, types of heads/covers on drawing sheet.	4	CO3
LLO 11.1 Apply industry-standard symbols and conventions to represent various unit operations in process flow diagrams and instrumentation diagram.	11	* Draw symbols for unit operation equipment's, instrumentation as per IS 3232 on drawing sheet.	4	CO4
LLO 12.1 Apply engineering principles and industry standards in the preparation of specification sheets for heat exchangers and batch reactors.	12	* Draw specification sheet for heat exchanger and batch reactor on drawing sheet.	4	CO4
LLO 13.1 Draw and describe block and flow diagrams of a given manufacturing process using appropriate symbols.	13	* Draw the block diagram, process flow diagram for given manufacturing processes (any two).	4	CO4
LLO 14.1 Draw and describe accurate process and instrumentation diagrams, utility line diagram of a given manufacturing process.	14	* Draw, process and instrumentation diagram, utility line diagram of manufacturing processes considered in practical no. 13.	4	CO4
LLO 15.1 Draw and describe accurate equipment layout and tank farm layout of a given manufacturing process.	15	* Draw equipment layout and tank farm layout of manufacturing processes considered in practical no. 13.	4	CO4
LLO 16.1 Apply industry standards and best practices in the design and analysis of storage tanks.	16	* Visit the nearby industry to observe the storage tank and calculate the thickness of storage tank for given fluid and compare the actual tank with the designed tank.	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

- NA

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 judicial 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	Visit to nearby industry .	16
2	Drawing sheet, Drawing board, Drawing kit	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	Computer Aided Drafting Software	CO1	6	2	4	4	10
2	II	Flanges, Support for Pipe and Vessel	CO2	10	2	4	6	12
3	III	Process Equipment Drawing	CO3	10	2	4	6	12
4	IV	Specification Sheet and Process Flow Diagrams	CO4	24	4	8	12	24
5	V	Basics of Chemical Engineering Design	CO5	10	2	4	6	12
Grand Total				**60**	**12**	**24**	**34**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Two class test of 30 marks

Term work of 25 marks

Summative Assessment (Assessment of Learning)

- End semester examination of 70 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	1	2	2	2	-	2	3.			
CO2	3	1	2	1	-	2	3			
CO3	3	2	2	1	-	2	3			
CO4	3	3	2	1	-	3	3			
CO5	3	2	3	2	2	2	3			

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	A .P. Gautam, Pradeep Jain	Engineering Autocad	Khanna Publishers ISBN-13: 978-9381068946
2	Richard Turton, Richard C. Bailic, Wallace B. Whiting, Joseph A. Shaeiwitz, Debangsu Bhattacharyya	Analysis, Synthesis and Design of Chemical Processes,	Published Jun 22, 2012 by Prentice Hall. Part of the Prentice Hall International Series in the Physical and Chemical Engineering Sciences series. ISBN-13: 978-0-13-261812-0
3	Richard Turton, Joseph A. Shaeiwitz	Chemical Process Equipment Design	Published Feb 1, 2017 by Prentice Hall. ISBN-13: 978-0-13-380447-8
4	D.G. Austin	Chemical Engineering Drawing Symbols	George Godwin Ltd (April 1979) ISBN-13: 978-0711433182
5	M. V. Joshi, V. V. Mahajani	Process Equipment Design (3 Edition)	Macmillan India Limited, 2000 ISBN: 0333924185, 9780333924181
6	M. Gopala Rao Marshal Sittig	Dryden's Outlines Of Chemical Technology	Affilated East-West Press Pvt Ltd. (1997) ISBN-13: 978-8185938790
7	Bureau of Indian Standards	IS 3232: Recommendations on Graphical Symbols for Process Flow Diagrams, Piping and Instrumentation Diagrams	Chemical Engineering Plants and Related Equipment (MED 17)
8	Dr S. D. Dawande.	Process Equipment Design Vol. 2 5/ed.	Denett & Company, ISBN-8190322893, 9788190322898

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.pveng.com/wp-content/uploads/2016/06/HeatExchanger_Drawing.pdf	Learning material

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Sr.No	Link / Portal	Description
2	https://www.essentialchemicalindustry.org/processes/chemical-reactors.html	Learning material
3	https://www.autodesk.com/education/free-software/autocad.	Learning material
4	https://www.autodesk.com/education/edu-software/overview	Learning material
5	https://hardhatengineer.com/types-of-pipe-support-use-in-pipeline/	Learning material
6	https://www.chemengstudent.com/complete-guide-to-designing-a-heat-exchanger/?v=13b5bfe96f3e	Learning material
7	https://www.shutterstock.com/search/shell-and-tube-heat-exchangers?msockid=11337b5010196a6631ff6ef5110c6ba3	Learning material
8	https://www.cadcrowd.com/3d-models/batch-reactor	Learning material
9	https://fact.co.in/images/upload/Technical_documents_8787.pdf	Learning material
10	P&ID https://www.lucidchart.com/pages/tutorial/p-and-id	Learning material
11	https://www.littlepeng.com/single-post/design-of-storage-tank	Learning material
12	https://kh.aquaenergyexpo.com/wp-content/uploads/2024/02/Storage-Tanks-Basis-Design-Of-Tanks.pdf	Learning material

Note :

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