GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)
Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)
Semester- 6
Course Title: Project engineering
(Course Code: 4360503)

Diploma programme in which this course is offered	Semester in which offered
Chemical Engineering	6th Semester

1.RATIONALE:

A project moves to completion through a series of stages starting from preliminary evaluation of economics and market to commercial production. Project engineering of a new chemical plant and the expansion or revision of existing one require the use of engineering principles and theories combined with consideration of practical limits imposed by industrial conditions. In this course special emphasis is given on the applied economics and engineering principles involved in the design of chemical plants. Use of these principles is highly required for any successful chemical engineer to work in the area of production, administration, sales, marketing, research, and development of a new chemical project.

2.COMPETENCY:

The course should be taught and curriculum should be implemented with the aim to develop required skills so that students are able to acquire following competency:

- **Gain knowledge of organization and implementation of project in terms of financial analysis when it comes to start up a new industry after undergoing all major subjects of chemical engineering.**
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3. COURSE OUTCOMES (COs):

The theory, experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

1. **Gain basic knowledge of chemical engineering plant and process design in industries.**
2. **Understand how a project to be started and concept of plant and process design.**
3. **Select process equipment or instruments of the same function based on both technical and commercial point of view.**
4. **Choose appropriate plant location and plant layout for project.**
5. **Apply knowledge of economic for project to run an industry in a profitable.**

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
3	0	0	3	30	70	0	0	100

(*):Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate the integration of COs, and the remaining 20 marks are the average of 2 tests to be taken during the semester for assessing the attainment of the cognitive domain UOs required for the attainment of the COs.

***Legends: L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit, **CA** - Continuous Assessment; **ESE**-End Semester Examination.*

5. SUGGESTED PRACTICAL EXERCISES:

The following practical outcomes (PrOs) are the sub-components of the COs. *Some of the **PrOs** marked **'*'** (in approx. Hrs column) are compulsory, as they are crucial for that particular CO at the 'Precision Level' of Dave's Taxonomy related to 'Psychomotor Domain'.*

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
	Not Applicable		

Note

i. More **Practical Exercises** can be designed and offered by the respective course teacher to develop the industry relevant skills/outcomes to match the COs. The above table is only a suggestive list**.**

ii. The following are some **sample** 'Process' and '#Product' related skills (more may be added/deleted depending on the course) that occur in the above listed **Practical Exercises** of this course required which are embedded in the COs and ultimately the competency.

Sr. No.	Sample Performance Indicators for the PrOs	Weightage in %
1	Handling of apparatus for precise measurements	10
2	Record observations correctly	20
3	Practice and adapt good and safe measuring techniques	10
4	Calculations, Interpretation of results and their conclusion.	20
5	Prepare report of practical in prescribed format	10
6	Solve assignment questions.	20
7	Viva-voce	10
	Total	**100**

6. MAJOR EQUIPMENTS/ INSTRUMENTS REQUIRED

These major equipment/instruments and Software required to develop PrOs are given below with broad specifications to facilitate procurement of them by the administrators/management of the institutes. This will ensure the conduction of practice in all institutions across the state in a proper way so that the desired skills are developed in students.

S. No.	Equipment Name with Broad Specifications	PrO. No.
1	**Not Applicable**	

7. AFFECTIVE DOMAIN OUTCOMES

The following ***sample*** Affective Domain Outcomes (ADOs) are embedded in many of the above-mentioned COs and PrOs. More could be added to fulfill the development of this competency.

a) Work as a leader/a team member.
b) Follow ethical practices
c) Observe safety measures
d) Good house keeping
e) Time management
f) Practice environmentally friendly methods and processes.

The ADOs are best developed through laboratory/field-based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

i. 'Valuing Level' in 1st year
ii. 'Organization Level' in 2nd year.
iii. 'Characterization Level' in 3rd year.

8. UNDERPINNING THEORY:

The major underpinning theory is given below based on the higher level UOs of *Revised Bloom's taxonomy* that are formulated for development of the Cos and competency. If required, more such higher-level UOs could be included by the course teacher to focus on the attainment of COs and competency.

Unit	Major Learning Outcomes(Course Outcomes in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
Unit – I **Introduction**	1a. Describe role of Chemical Engineer. 1b. Justify the need of plant design. 1c. Explain chemical Engineering Design. 1d. Describe criteria for good designs. 1e. Explain Process design.	1.1 Role of Chemical Engineer. 1.2 Chemical Engineering Design. 1.3 Need of plant design. 1.4 Process Design 1.5 Design and selection of chemical engineering equipment 1.6 Criteria for good design
Unit– II Development of project for plant and process design	2a. List of chemical engineering plant project objective 2b. Describe process evolution stages. 2c. Explain pilot plant 2d. Explain components of chemical Engineering plant Design factor 2e. Explain source of information. 2f. Explain Process design and its components	2.1 chemical engineering plant project objective. 2.2 Process evolution stages and their Importance. 2.3 Plant design factors 2.3.1 Technical factors 2.3.2 Economic factors 2.3.3 Legal factors 2.3.4 Safety and sanitation. 2.4 Source of Information. 2.5 Continuous v/s Batch processing, 2.6 Shift and Operating schedules 2.7 Types of flow diagrams.

Unit– III **Selection of chemical engineering equipments**	3a. Explain Plan for selection of equipment 3b. Differentiate Standard and special equipment 3c. Prepare specification sheet for equipments 3d. Select appropriate equipments 3e. Explain piping and insulation 3f. Classify different insulation.	3.1 selection of material 3.2 Plan for selection of equipment 3.3 Selection of process equipments and specification sheet for equipment 3.4 Standard v/s Special equipment. 3.5 Selection of equipments (a) Size reduction equipment, (b) Heat transfer equipment, (c) Material handling equipment (d) Mass transfer equipment (e) Pumps 3.6 Piping, Pipe strength and wall thickness 3.7 Piping design problems, 3.8 Types of insulation, Factors governing selection of insulation.
Unit– IV **Plant Layout and Location**	4a. Describe principles of plant layout 4b. Explain factors affecting plant location	4.1 Factors of plant layout 4.2 Principles of plant layout 4.3 Factors for selection of plant location: Primary factors and specific factors
Unit– V **Economic evaluation of the project**	5a. Evaluate total capital investment 5b. Estimate equipment cost solve the numerical based on cost indices 5c. Explain types of depreciation 5d. Calculate depreciation using different methods 5e. Identify components of total product cost 5f. Estimate profitability 5g. Calculate break-even capacity	5.1 Capital investment. 5.2 Fixed capital investment, 5.3 Working capital investment. 5.4 Cost Indices, Cost-Size relation, and cost-Time relation. 5.5 Numerical based on Cost Indices 5.6 Depreciation and it's types 5.7 Methods for determining depreciations Arbitrary methods, Methods with interest on investment 5.8 Numeric based on depreciation. 5.9 Total product cost (TPC) 5.10 Net and gross earnings 5.11 Percent return on investment, Turnover ratio. 5.12 Break-even analysis (Analytical method) 5.13 Break-even chart (Graphical method) 5.14 Numerical of Break-even analysis

9.SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN:

Unit	Unit Title	Teaching	Distribution of Theory Marks

No.		Hours	R Level	U Level	A Level	Total Marks
I	**Introduction**	06	02	06	02	10
II	**Development of project for plant and process design**	08	02	10	04	16
III	**Selection of chemical engineering equipments**	10	02	10	04	16
IV	**Plant Layout and Location**	04	02	06	00	08
V	**Economic evaluation of the project**	14	04	08	08	20
Total		**42**	**12**	**40**	**18**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)*
Note*: This specification table provides general guidelines to assist students for their learning and to teachers to teach and question paper designers/setters to formulate test items/questions to assess the attainment of the UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may slightly vary from above table.*

10. SUGGESTED STUDENT ACTIVITIES:

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should perform following activities in group and prepare reports of about 5 pages for each activity. They should also collect/record physical evidences for their (student's) portfolio which may be useful for their placement interviews:

Following is the list of proposed student activities like:

1. Assignments
2. Technical Quiz/MCQ Test
3. Presentation on some course topic
4. I-net based assignments
5. Undertake micro-Project in team/individually

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any):

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a) Massive open online courses (*MOOCs*) may be used to teach various topics/subtopics.
b) Guide student(s) in undertaking micro-projects/activities.
c) Different types of teaching methods i.e. video demonstration, activity based learning, case study, m-learning need to be employed by teachers to develop the outcomes.
d) Some *of the topics/sub-topics* which are relatively simpler or descriptive are to be given to the students for *self-learning* but to be assessed using different assessment methods.
e) Teachers need to ensure to create opportunities and provisions for *co-curricular activities*.
f) Guide students to address issues on environment and sustainability with reference to using the knowledge of this course
g) OERs, Vlab, and Olabs may be used to teach for the teaching of different concepts.

12. SUGGESTED MICRO-PROJECTS:

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her at the beginning of the semester. In the first four semesters, the micro-project is group-based (group of 3 to 5). However, **in the fifth and sixth semesters**, the number of students in the group should ***not exceed three.***

The micro-project could be industry application-based, internet-based, workshop-based, laboratory-based, or field-based. Each micro-project should encompass two or more COs which are the integration of PrOs, UOs, and ADOs. Each student will have to maintain a dated work diary consisting of individual contributions in the project work and give a seminar presentation of it before submission. The duration of the micro project should be about **14-16** ***(fourteen to sixteen) student engagement hours*** during the course. The student sought to submit micro-project by the end of the semester (so that they develop industry-oriented COs.A suggestive list of micro-projects is given here. This should relate highly to the competency of the course and the COs. Similar micro-projects could be added by the concerned course teacher.

1 Prepare chart/model of economic evolution or cost estimation of given project.
2 Prepare chart of process design.
3 Prepare chart/model types flow diagram.
4 Prepare specification sheet of equipment of given project.
5 Draw suitable chart for plant design.
6 Prepare 15-20 slides power point presentation on any topic of project engineering.
7 Prepare material balance diagram of given project.
8 Prepare detailed IPD (instrumentation and process diagram) of given project.
9 Prepare plant layout of given project.
10 Prepare block flow diagram of given project.

13. SUGGESTED LEARNING RESOURCES:

(A) Books

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Chemical Engineering Plant Design.	Vilbrandt, Frank Carl and Dryden,Charles E.	McGraw Hill, New Delhi, 4th edition
2	Plant Design and Economics for Chemical Engineers,	Peters, Max and Klaus Timmerhaus	McGraw Hill, New Delhi, 4th edition
3	Chemical engineering Design *Principles, Practice and Economics of Plant and Process Design*	Gavin towler Ray sinnott	Butterworth-Heinemann Elsevier (2008)
4	Process Engineering Economics	Couper, James R.	Marcel and Dekker

14. SOFTWARE/LEARNING WEBSITES:

- https://nptel.ac.in
- www.cheresources.com
- http://people.clarkson.edu/~wwilcox/Design/refcosts.html
- http://app.knovel.com/web/toc.v/cid:kpCEDPPEP4
- https://www.lib.utexas.edu/chem/info/chemengecon.html
- http://www.mhhe.com/engcs/chemical/peters/data/ce.html

15. PO-COMPETENCY-CO MAPPING:

Semester	Project engineering (4360503)						
	POs						
Competency & Course Outco mes	PO 1 Basic & Discipline specific knowledge	PO 2 Problem Analysis	PO 3 Design/ development of solutions	PO 4 Engineering Tools, Experimentation & Testing	PO 5 Engineering practices for society, sustainability & environment	PO 6 Project Management	PO 7 Life- long learning
Competency	**Gain knowledge of organization and implementation of project in terms of financial analysis when it comes to start up a new industry after undergoing all major subjects of chemical engineering.**						
Gain basic knowledge of chemical engineering plant and process design in industries.	**3**	**1**	**2**	**-**	**2**	**1**	**1**
Understand how a project to be started and concept of plant and process design.	**3**	**2**	**2**	**-**	**1**	**1**	**1**
Select process equipment or instruments of the same function based on both technical and commercial point of view.	**3**	**2**	**2**	**-**	**2**	**1**	**1**
Choose appropriate plant location and plant layout for project.	**2**	**1**	**2**	**-**	**1**	**1**	**1**
Apply knowledge of economic for project to run an industry in a profitable.	**2**	**3**	**2**	**-**	**1**	**2**	**2**

*Legend: '**3**' for high, '**2**' for medium, **'1'** for low and **'-'** for no correlation of each CO with PO.*

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE:

GTU Resource Persons:

Sr. no	Name and Designation	Institute	Contact No.	Email
1	Mr. SHUKLA HARSH BHARATKUMAR	SHRI K. J. POLYTECHNIC, BHARUCH		hb_ch20@yahoo.com
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