



# GUJARAT TECHNOLOGICAL UNIVERSITY

**Bachelor of Engineering**

**Subject Code: 3153616**

**Semester – V**

**Subject Name: Elements of Plant Design & Economics**

**Type of course: Chemical Technology**

**Prerequisite:** Should have studied departmental fundamental chemical engineering subjects in previous semesters. Basic knowledge of chemical engineering is required.

**Rationale:** The objective of this course is to provide a means to teach undergraduate chemical technology students the basic aspects of plant design and economic aspect related to early implementation of projects and their current practices.

**Teaching and Examination Scheme:**

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	0	3	70	30	0	0	100

**Content:**

Sr. No.	Content	Total Hrs
1.	<b>Introduction:</b> Basic considerations in chemical engineering plant design, optimization and feasibility of plant design.	3
2.	<b>Process design aspects:</b> Selection of process-factors affecting process selection. Types of project design, Importance of Laboratory development pilot plant, Safety factors, types of flow diagrams.	3
3.	<b>Selection of process equipment:</b> Standard versus special equipment-material of construction for process equipment, selection criteria, and specification sheets.	3
4.	<b>Process auxiliaries and Process utilities</b> Piping design, layout, and supports for piping insulations. Pipe fittings, types of valves, selection of valves, process control and instrumentation control system design. Process water, boiler feed water, water treatment, waste treatment and disposal, steam, oil heating system, chilling plant, compressed air and vacuum.	4
5.	<b>Plant location and layout:</b> Factors affecting plant location, factors in planning layouts, principles of plant layout, use of scale models.	4
6.	<b>Cost estimation:</b> Cash flow and cumulative cash position for industrial operations, factors affecting	



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	estimation of investment and production cost, breakeven point and its significance, total capital investment, fixed and working capital investment & their estimations, type of estimates, cost indexes, method for estimating capital investment.	6
7.	<b>Estimation of total product cost</b> Estimation of total product cost: manufacturing cost, general expenses, Manufacturing cost: direct production cost, fixed charges, plant overhead cost.	4
8.	<b>Depreciation:</b> Types of depreciation, service life, salvage value and present value of assets. Methods of determining depreciation like straight-line method, declining-balance method. Sum-of the years-digits method, sinking-fund method.	5
9.	<b>Profitability, alternative investments and replacement:</b> Methods for profitability evaluation, Evaluation of Break Even Point, % rate of return, Practical factors in alternative investment and replacement Studies.	5
10.	<b>Project management:</b> Planning of project schedule by BAR CHART, Inventory control scheduling a project using CPM/PERT methods.	5

### Suggested Specification table with Marks (Theory): (For BE only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
30	15	15	5	5	0

**Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)**

### Reference Books:

1. M.S. Peters and Timmerhaus, "Plant design and Economics for Chemical Engineers", McGraw Hill 3rd Edition.
2. Chemical project economics, Mahajani V. V. and Mokashi S. M.
3. Project Planning and Control with PERT & CPM. Dr. B.C. Punmia & K.K. Khandelwal-fourth edition -2002.
4. F.C. Vibrandt and C.E. Dryden, "Chemical Engineering Plant Design", McGraw Hill Fifth Edition.
5. Coulson & Richardson's Chemical Engineering Volume 6, Butterworth-Heinemann, 1999, 3<sup>rd</sup> Edition
6. Industrial Engineering and Management by O. P. Khanna, Dhanpat Rai & Sons, 1985 7<sup>th</sup> Edition.
7. Project Engineering: Suhas Mokashi, Mcmillan Publisher.

### Course Outcomes:

Sr. No.	CO statement	Marks % weightage
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CO-1	To learn basic economic concept, to understand and apply this concepts in the project works undertaken and to chemical engineering situation by solving problem. Carry out the primary techno-economic feasibility of project.	30
CO-2	Evaluate the project cost including capital investment, product cost, breakeven point, depreciation cost for equipment and the total project cost.	25
CO-3	Control and schedule of the project using CPM/PERT technique, calculations.	20
CO-4	Solve problem on profitability and replacement analysis.	25

### List of Open Source Software/learning website:

- NPTEL lecture series
- Literature available on Plant design and project Economics.
- MIT Open course lecture