

**LOK JAGRUTI UNIVERSITY (LJU)**  
**INSTITUTE OF ENGINEERING AND TECHNOLOGY**

Department of Chemical Engineering (708)

Bachelor of Engineering (B.E.) - Semester – VI

|                      |                            |
|----------------------|----------------------------|
| Course Code:         | 017085601                  |
| Course Name:         | Plant Design and Economics |
| Category of Course:  | Open Elective Course (OEC) |
| Prerequisite Course: | ---                        |

| Teaching Scheme |              |               |        |             |
|-----------------|--------------|---------------|--------|-------------|
| Lecture (L)     | Tutorial (T) | Practical (P) | Credit | Total Hours |
| 3               | 0            | 0             | 3      | 30          |

| Syllabus |  |                    |                  |                |
|----------|--|--------------------|------------------|----------------|
| Unit No. | Topic  | Prerequisite Topic | Successive Topic | Teaching Hours |
| 01       | <b>Introduction to Plant Design</b>  |                    |                  | 2<br>(7%)      |
|          | 1.1 Plant design in Chemical engineering,  | ---                | ---              |                |
|          | 1.2 Optimization of plant design   | ---                | ---              |                |
|          | 1.3 Feasibility of plant design  | ---                | ---              |                |
| 02       | <b>Introduction to Process design</b>  |                    |                  | 3<br>(10%)     |
|          | 2.1 Factors affecting process selection - Selection of process                         | ---                | ---              |                |
|          | 2.2 Types of project design  | ---                | ---              |                |
|          | 2.3 Safety factors   | ---                | ---              |                |
|          | 2.4 Types of flow diagrams   | ---                | ---              |                |
| 03       | <b>Selection of Process Equipment</b>  |                    |                  | 3<br>(10%)     |
|          | 3.1 Standard versus special equipment  | ---                | ---              |                |
|          | 3.2 Material of construction for process equipment                                     | ---                | ---              |                |
|          | 3.3 Selection criteria   | ---                | ---              |                |
|          | 3.4 Specification sheets   | ---                | ---              |                |
| 04       | <b>Process auxiliaries and Process utilities</b>                                       |                    |                  | 4<br>(13%)     |
|          | 4.1 Piping design, layout, and supports for piping insulations                         | ---                | ---              |                |
|          | 4.2 Pipe fittings, types of valves, selection of valves                                | ---                | ---              |                |
|          | 4.3 Process control and instrumentation control system design                          | ---                | ---              |                |
|          | 4.4 Process water, boiler feed water, water treatment, waste treatment and disposal    | ---                | ---              |                |
|          | 4.5 Disposal steam, oil heating system, chilling plant, compressed air and vacuum.     | ---                | ---              |                |
| 05       | <b>Plant location and Plant layout</b>   |                    |                  | 3<br>(10%)     |
|          | 5.1 Factors affecting plant location   | ---                | ---              |                |
|          | 5.2 Factors in planning layouts  | ---                | ---              |                |
|          | 5.3 Principles of plant layout, use of scale models                                    | ---                | ---              |                |
| 06       | <b>Cost estimation</b>   |                    |                  | 4<br>(13%)     |
|          | 6.1 Cash flow and cumulative cash position for industrial operations                   | ---                | ---              |                |
|          | 6.2 Factors affecting estimation of investment and production cost                     | ---                | ---              |                |
|          | 6.3 Breakeven point and its significance   | ---                | ---              |                |
|          | 6.4 Total capital investment, fixed and working capital investment & their estimations | ---                | ---              |                |
|          | 6.5 Method for estimating capital investment   | ---                | ---              |                |
| 07       | <b>Total product cost estimation</b>   |                    |                  | 3<br>(10%)     |
|          | 7.1 Estimation of total product cost: manufacturing cost, general expenses             | ---                | ---              |                |
|          | 7.2 Manufacturing cost: direct production cost   | ---                | ---              |                |
|          | 7.3 Fixed charges, plant overhead cost.  | ---                | ---              |                |
| 08       | <b>Depreciation</b>  |                    |                  | 3<br>(10%)     |
|          | 8.1 Types of depreciation  | ---                | ---              |                |
|          | 8.2 Method for determining depreciation  | ---                | ---              |                |
|          | 8.3 Straight line method, decline balance method                                       | ---                | ---              |                |
|          | 8.4 Sum of the year digit method, shrinking fund method                                | ---                | ---              |                |
|          | 8.5 Single unit and group depreciation   | ---                | ---              |                |
|          | 8.6 Evaluation of depreciation methods   | ---                | ---              |                |
| 09       | <b>Project management</b>  |                    |                  | 3<br>(10%)     |
|          | 9.1 Planning of project schedule by BAR CHART  | ---                | ---              |                |
|          | 9.2 Inventory control scheduling a project   | ---                | ---              |                |
|          | 9.3 CPM/PERT methods   | ---                | ---              |                |
| 10       | <b>Profitability, alternative investments and replacement</b>                          |                    |                  | 2<br>(7%)      |
|          | 10.1 Methods for profitability evaluation  | ---                | ---              |                |
|          | 10.2 Evaluation of Break Even Point  | ---                | ---              |                |
|          | 10.3 Rate of return  | ---                | ---              |                |
|          | 10.4 Practical factors in alternative investment and replacement Studies               | ---                | ---              |                |

**Proposed Theory + Practical Evaluation Scheme by Academicians  
(% Weightage Category Wise and it's Marks Distribution)**

|           |          |           |          |           |          |
|-----------|----------|-----------|----------|-----------|----------|
| <b>L:</b> | <b>3</b> | <b>T:</b> | <b>0</b> | <b>P:</b> | <b>0</b> |
|-----------|----------|-----------|----------|-----------|----------|

**Note: In Theory Group, Total 4 Test (T1+T2+T3+T4) will be conducted for each subject.  
Each Test will be of 25 Marks.  
Each Test Syllabus Weightage: Range should be 20% - 30%**

| Group (Theory or Practical) | Group (Theory or Practical) Credit | Total Subject Credit | Category                            | % Weightage                | Marks Weightage |            |
|-----------------------------|------------------------------------|----------------------|-------------------------------------|----------------------------|-----------------|------------|
| Theory                      | <b>3</b>                           | <b>3</b>             | MCQ                                 | 55%                        | 55              |            |
| Theory                      |                                    |                      | Theory Descriptive                  | 30%                        | 30              |            |
| Theory                      |                                    |                      | Formulas and Derivation             | 0%                         | 0               |            |
| Theory                      |                                    |                      | Numerical                           | 15%                        | 15              |            |
| <b>Expected Theory %</b>    | <b>100%</b>                        |                      |                                     | <b>Calculated Theory %</b> | <b>100%</b>     | <b>100</b> |
| Practical                   | <b>0</b>                           |                      | Individual Project                  | 0%                         | 0               |            |
| Practical                   |                                    |                      | Group Project                       | 0%                         | 0               |            |
| Practical                   |                                    |                      | Internal Practical Evaluation (IPE) | 0%                         | 0               |            |
| Practical                   |                                    |                      | Viva                                | 0%                         | 0               |            |
| Practical                   |                                    |                      | Seminar                             | 0%                         | 0               |            |
| <b>Expected Practical %</b> | <b>0%</b>                          |                      | <b>Calculated Practical %</b>       | <b>0%</b>                  | <b>0</b>        |            |
| <b>Overall %</b>            | <b>100%</b>                        |                      |                                     | <b>100%</b>                | <b>100</b>      |            |

**Course Outcome**

|   |  |
|---|--|
| 1 | To understand the fundamentals of plant design in chemical engineering, including the optimization and feasibility considerations involved. Also differentiate between standard and special process equipment and make informed decisions regarding their selection.   |
| 2 | To develop knowledge and skills in the treatment and management of process utilities such as process water, boiler feed water, and waste disposal, including steam, oil heating, chilling, compressed air, and vacuum systems  |
| 3 | To demonstrate proficiency in cost estimation techniques, including the calculation of cash flow and cumulative cash positions for industrial operations. Also understand the components of total capital investment, fixed capital investment, and working capital investment, and estimate them effectively. |
| 4 | To understand depreciation methods, project management techniques, and profitability evaluation for effective decision-making in industrial contexts.  |

**Suggested Reference Books**

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|---|--|
| 1 | “Plant design and Economics for Chemical Engineers”, M.S. Peters and Timmerhaus, McGraw Hill 3rd Edition |
| 2 | “Chemical Engineering Plant Design”, F.C. Vibrandt and C.E. Dryden, McGraw Hill Fifth Edition            |
| 3 | Coulson & Richardson’s Chemical Engineering Volume 6, Butterworth-Heinemann, 1999 ,3rd Edition           |

**List of Open Source Software/Learning Website**

|   |   |
|---|---|
| 1 | <a href="https://nptel.ac.in/courses/103105166">https://nptel.ac.in/courses/103105166</a> |
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