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| **Course code** | **Course name** | **Course Category** | **L-T-P** | **Credits** |
| 20CHXXXX | SCALE-UP METHODS | PEC | 3-0-0 | 3 |

**Course Content:**

**Unit I (7 Contact hours)**

Principals of Similarity, Pilot Plants & Models: Introduction to scale-up methods, pilot plants models, Principles of similarity, Industrial applications.

**Unit II (7 Contact hours)**

Dimensional Analysis and Scale-Up Criterion: Dimensional analysis, regime concept, similarity criterion and scale up methods used in chemical engineering, Experimental techniques for scale-up.

**Unit III (7 Contact hours)**

Scale-Up of Mechanical Unit Operations equipment: Typical problems in scale up of mixing equipment, thickener, cyclone separator, settlers, etc.

**Unit IV (7 Contact hours)**

Scale-Up of Heat Transfer Equipment: Heat Exchanger, Evaporators , etc.

**Unit V (7 Contact hours)**

Scale-Up of Chemical Reactors: Kinetics, reactor development & scale-up techniques for chemical reactors.

**Unit VI (7 Contact hours)**

Scale-Up of Distillation Column & Packed Towers: Scale-up of distillation columns and packed towers for continuous and batch processes , etc.

**Learning Resources:**

**Reference Books:**

1. Johnstone and Thring, Pilot Plants Models and Scale-up methods in Chemical Engg., McGraw Hill, New York, 1962.
2. W. Hoyle, Pilot Plants and Scale-Up, Royal Society of Chemistry, 1st Edition, 1999.
3. Marko Zlokarnik, Dimensional Analysis and Scale-up in Chemical Engineering, Springer Verlag, Berlin, Germany,1991.
4. E. Bruce Nauman, Chemical Reactor Design, Optimization and Scale-up, McGraw Hill, New York, 2002.

**Course outcomes:** At the end of the course, the student will be able to

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| --- | --- |
| CO 1 | Understand scale up in chemical engineering plants. |
| CO 2 | Apply dimensional analysis technique for scale up problems |
| CO 3 | Scale up of chemical reactors. |
| CO 4 | Scale up mixers and heat exchangers, distillation columns and packed towers. |

**Assessment Method**

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| --- | --- | --- | --- | --- |
| Assessment Tool | Weekly tests/Assignments(In semester) | Monthly tests(In semester) | End Semester Test | Total |
| Weightage (%) | 10% | 30% | 60% | 100% |

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| **Course code** | **Course name** | **Course Category** | **L-T-P** | **Credits** |
| 20CHXXXX | PLANT UTILITIES | PEC | 3-0-0 | 3 |

**Course Content:**

**Unit I (5 Contact hours)**

Importance of Process utilities in Chemical Plant: Different utilities - water, steam, compressed air, vacuum, refrigerants, their properties and requirements, selection and application of different utilities.

**Unit II (5 Contact hours)**

Compressed air and Vacuum: Use of Compressed air, process air and instrument air, Process of getting instrument air, Vacuum.

**Unit III (5 Contact hours)**

Steam: Properties of steam, types of steam generator / Boiler, steam handling and distribution, steam traps, steam nozzles, Scaling, trouble shooting, preparing boiler for inspection, Boiler Act.

**Unit IV (5 Contact hours)**

Power Generation: Internal Combustion engines, Gas turbines, steam power plants.

**Unit V (5 Contact hours)**

Refrigeration: Refrigeration cycles, Different methods of refrigeration used in industry, different refrigerants, Simple calculation of C.O.P. Refrigerating effects.

Liquefaction processes: Liquefaction process, liquefaction of air, liquefaction of natural gas.

**Unit VI (5 Contact hours)**

Water: Hard and soft water, water treatment, Water Resources, storage and distribution of water resources and conservation of water.

**Learning Resources:**

**Reference Books:**

1. Jorgenson R., Fan Engineering, Buffalo Rorge Co., 8th Edition, 1983.
2. Lyle, O., Efficient Use of Steam, HMSO, London, 1974.
3. Stoecker, W.F., Refrigeration and Air Conditioning, Mc-Graw Hill, 2nd Edition, 1983.
4. Chattopadhyay, P., Boiler operations engineering, Tata McGraw Hill, 1998.
5. Perry R.H., Green D.W., Perry’s chemical Engineer’s Handbook, McGraw Hill, NewYork, 8th Edition, 2007.

**Course outcomes:** At the end of the course, the student will be able to

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| --- | --- |
| CO 1 | List utilities in a plant. |
| CO 2 | Understand properties of steam and operation of boilers for steam generation |
| CO 3 | Understand refrigeration methods used in industry. |
| CO 4 | Compare power generation methods |
| CO 5 | Classify and describe the types of water, water treatment methods, storage and distribution techniques. |

**Assessment Method**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Assessment Tool | Weekly tests/Assignments(In semester) | Monthly tests(In semester) | End Semester Test | Total |
| Weightage (%) | 10% | 30% | 60% | 100% |