Gyanmanjari Innovative University

Syllabus
Gyanmanjari Science College
Semester-I(M.Sc.)

Subject: Unit Operations & Unit Processes – I-MSCIN11501

Type of course: Major

Prerequisite: Students should have a basic knowledge of Industrial methods. These subjects provide the theoretical and mathematical framework for analyzing and designing chemical and physical transformations on an industrial scale.

Rationale: To understand the fundamentals to chemical engineering and the design of chemical plants. They provide framework for understanding, analyzing, and designing industrial-scale manufacturing processes.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks					Total Marks
				Theory Marks		Practical Marks		CA	
CI	T	P	C	ESE	MSE	V	P	ALA	
4	0	0	4	60	30	10	00	50	150

Legends: CI-Class Room Instructions; T – Tutorial; P - Practical; C – Credit; ESE - End Semester Examination; MSE- Mid Semester Examination; V – Viva; CA - Continuous Assessment; ALA- Active Learning Activities.

CourseContent:

Unit No.	Course content	Hrs	% Weightage
1	**Crystallization and Gas absorption**: - Introduction of crystallization, solubility, theory of supersaturating, methods of super saturation. Crystallization equipment: Agitated tank crystallizer, Oslo evaporative crystallizer, Oslo cooler crystallizer, Draft tube crystallizer. Introduction of gas absorption, comparison of gas absorption and distillation, selection criteria for solvent gas absorption. Absorption equipment: Mechanically agitated vessel, packed column/tower	15	25
2	**Size reduction and Mixing**: - Concept and importance of size reduction. Primary Crushers: Black Jaw crusher, Gyratory crusher. Secondary crushers: Smooth roll crusher, Tooth rolls crusher, Hammer mill, Ball mill. Cutter: Rotary Knife cutter. Concept and types of mixtures, mixing liquids with liquids, construction and flow patterns of impellers, types of agitators, Mixing of gases with liquids. Type of solid-solid and solid-liquid mixtures, ribbon blender, Muller mixture, tumblers.	15	25
3	**Sulphonation**:- Introduction, Mechanism. Industrial production of any two compound by Sulphonation. **Nitration**: - Introduction,Mechanism. Industrial production of any two compound by Nitration. **Amination**: -Introduction, Mechanism. Industrial production of any two compound by Amination.	15	25
4.	**Halogenation**: - Introduction, Mechanism. Industrial production of any two compound by Halogenation **Hydrogenation**: - Introduction, Mechanism. Industrial production of any two compound by Hydrogenation. **Hydrolysis**: - Introduction, Mechanism. Industrial production of any two compound by Hydrolysis.	15	25
	Total	60	100

Continuous Assessment:

Sr. No	Active Learning Activities	Marks
1.	**Hands-on Crystal Growing Lab** Faculty will assign Students have to create a supersaturated solution of a substance like sugar (to make rock candy) or salt. Then they suspend a string or stick in the solution and observe crystal formation over several days. Student will make a report and Upload it on GMIU Web portal.	10
2.	**Case Studies:** Faculty will Provide real-world scenarios from different industries (e.g., pharmaceuticals, food processing, construction) where size reduction and mixing are critical. Students can work in groups to analyze the problem and propose a solution and note down in report. The report must be submitted on GMIU Web portal	10
3.	**Blank Flowchart:** Faculty will Provide to students with a blank flowchart template with boxes for each stage (e.g., "Starting Material," "Reagent," "Intermediate," "Product"). Students must fill in the blanks with the correct chemical names or structures. Upload the details on GMIU Web portal.	10
4.	**Template Design:** Propagation: Faculty will assign the topic/reaction to students and they have to identify a loop or cycle with blank boxes for intermediates and reactants then they written a **summary** or **analysis paper** discussing the legal issues involved present their findings in a clear and organized manner. Upload it on GMIU Web portal.	10
5.	**Conceptual and Modeling Activities** Faculty will instruct about a real-world gas absorption challenge, such as removing a specific pollutant from industrial emissions. Students can research and propose different absorption techniques, select an appropriate solvent, and justify their choices based on factors like efficiency, cost, safety, and environmental impact. Student must prepare the chart and submit it on GMIU Web portal.	10
Total		**50**

Suggested Specification table with Marks (Theory):60

Distribution of Theory Marks (Revised Bloom's Taxonomy)						
Level	Remembrance (R)	Understanding (U)	Application (A)	Analyze (N)	Evaluate (E)	Create (C)
Weightage	35%	35%	30%	00	00	00

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Course Outcome:

After learning the course the students should be able to:	
CO1	Explain the basic concepts of crystallization, including supersaturation, nucleation, and crystal growth.
CO2	Understand the factors that affect the efficiency and outcome of both size reduction and mixing processes, such as material hardness, moisture content, particle shape, and equipment speed.
CO3	Apply the products of sulphonation for different starting materials, including substituted aromatic compounds
CO4	Define halogenation and identify the common halogens used in these reactions.

Instructional Method:

The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.

From the content 10% topics are suggested for flipped mode instruction.

Students will use supplementary resources such as online videos, NPTEL/SWAYAM videos, e-courses, Virtual Laboratory

The internal evaluation will be done on the basis of Active Learning Assignment

Practical/Viva examination will be conducted at the end of semester for evaluation of performance of students in laboratory.

Reference Books:

1. Introduction to chemical engineering By Walter L. Badger, J. T. Bancharo, McGraw Hill Book Co..

2. Chemical engineering Vol. 1 to 6 By Coulson and J.F.Richardson, Pergaman Press

3. Chemical process principles Vol.1 by Hodgen

4. Elementary principles of chemical processes by Richa Ronald, W. Rousseau, John Willey and Son.

5. Unit processes in organic synthesis by P. H. Groggins.