Gyanmanjari Innovative University

Course Syllabus
Gyanmanjari Institute of Technology
Semester-1 (M.Tech)

Subject: Process Plant Design and flow sheeting-METCH11507

Type of course: Minor Stream

Prerequisite: The student should have basic understanding of Chemical Engineering Economics and Plant design.

Rationale: Method Chemical plant project development and design are the focus of plant design and flow sheeting. Plant layout, flow diagrams, and other design considerations are also developed as the project progresses. Additionally, the advanced comprehension of the numerous process auxiliary and utility tools utilized in chemical plants is covered in this course.

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	2	5	60	30	10	20	30	150

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

Course Content:

Sr. No	Course content	Hrs	% Weightage
1	Introduction: Basic concepts, General Design Considerations, Process design development, layout of plant items, Economic aspects and optimum design, Practical considerations in design and engineering ethics, Network analysis, PERT/CPM	12	20
2	Analysis of cost estimation, Factors affecting investment and production costs, Estimation of capital Investment and total product cost, Interests, Time value of money, Taxes and Fixed Charges, Salvage value, Depreciation calculation	12	20
3	Flow-sheeting: Synthesis of flow sheet: Propositional logic and semantic equations, Deduction theorem; Algorithmic flow sheet generation using P-graph theory, Sequencing of operating units, Feasibility and optimization of flow sheet using various algorithms viz, Solution Structure Generation (SSG), Maximal Structure Generation (MSG), Simplex, Branch-and-bound etc.	12	20
4	Optimum Design and Design Strategy: Break-even analysis, Optimum production rates in plant operation, Optimum batch cycle time applied to evaporator and filter press, Economic pipe diameter, Optimum insulation thickness, Optimum cooling water flow rate and optimum distillation reflux ratio.	12	20
5	Process Auxiliaries: Basic considerations and flow diagrams in chemical engineering plant design. Piping design: Selection of material, pipe sizes, working pressure, Basic principles of piping design, piping drawings, pipe installations, overhead installations, Process steam piping, selection and determination of steam – pipe size, Piping insulation, application of piping insulation, weather proof and fire resisting pipe insulation jackets, piping fittings, pipe joints. Valves: Types of valves, selection criteria of valves for various systems. Pumps: Types of pumps	12	20

Continuous Assessment:

Sr. No	Active Learning Activities	Marks
1	**Preparation of Multimedia Presentations on Process Plant Design Topics:** In this activity, students will prepare PowerPoint slides incorporating videos, animations, pictures, and graphics for better understanding of theoretical concepts related to *Process Plant Design and Flow Sheeting*. Faculty will allocate specific chapters or parts of chapters to student groups so that the entire syllabus is covered collectively. Students will present their work in class and submit the final presentation file on the GMIU Web Portal.	10
2	**Flow-Sheet Simulation using DWSIM:** In this activity, students will create and simulate chemical process flow sheets using DWSIM (open-source CAPE-OPEN compliant simulator). They will model basic unit operations, analyze mass and energy balances, and optimize process parameters. The simulation results and observations will be compiled into a technical report and uploaded on the GMIU Web Portal.	10
3	**Economic Evaluation of a Chemical Plant:** Students will perform an economic analysis for a selected process plant, including capital cost estimation, operating cost, depreciation, and profitability analysis. They will apply cost estimation techniques and prepare a detailed report summarizing their evaluation and conclusions. The final report will be submitted on the GMIU Web Portal.	10
Total		30

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	10%	40%	40%	05%	05%	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	Design and develop a chemical process and perform a complete economic analysis of the plant.
CO2	Evaluate the profitability of process for chemical plant
CO3	Use commercial flowsheeting software to simulate plant
CO4	Analyze optimal condition for plant with process auxiliaries and utilities

List of Suggested Practical

Sr. No	Suggested Practical
1	Flowsheeting tutorials in DWSIM (open-source CAPE-OPEN compliant chemical process simulator)
2	Capital cost estimate in DWSIM (estimate capital and operating cost for a chemical plant based on data from the flowsheet)

Instructional Method:

The course delivery method will depend upon the requirement of content and the needs of students. The teacher, in addition to conventional teaching methods by black board, may also use any 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. 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 the laboratory.

Reference Books:

[1]. M.S. Peters and Timmerhaus, Plant design and Economics for Chemical Engineers, McGraw Hill 4th Edition.

[2]. F.C. Vibrandt and C.E. Dryden, Chemical Engineering Plant Design, McGraw Hill, 5th Edition.

[3]. Anil Kumar, Chemical Process Synthesis and Engineering Design, Tata McGRaw Hill (1982)

[4]. Roger Hunt and Ed Bausbacher, Process Plant layout and Piping Design, PTR Prentice-Hall Inc.

[5]. Jack Broughton; Process utility systems; Institution of Chem. Engineers, U.K.