



SARVAJANIK
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SARVAJANIK UNIVERSITY
Sarvajani College of Engineering and Technology



Bachelor of Technology (B.Tech)

B. Tech. Semester VII

Subject Name: Computer Aided Process Synthesis

Subject Code: BTCH14702

Type of course: Professional Elective Course

Prerequisite: Chemical Reaction Engineering, Mass transfer Operations I & II,
Chemical Engineering Thermodynamics – I & II

Rationale: This course content offers detailed process synthesis step for process design. It includes the concepts of reactor, heat exchanger, separator network design and batch scheduling.

Teaching and Examination Scheme:

TEACHING SCHEME				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	150
3	0	2	4	60	25	15	30	20	

CA1: Continuous Assessment (assignments/projects/open book tests/closed book tests CA2: Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems TEE: Term End Examination TEP: Term End Practical Exam (Performance and viva on practical skills learned in course) CA3: Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	Introduction to product and process design Design opportunity, steps for product and process design, Environmental and safety considerations, role of computers, heuristics for process synthesis	9	15
2	Reactor network design Reactor Models, Reactor Design for Complex Configurations, Reactor Network Design Using the Attainable Region	8	14
3	Heat Exchanger Network Design Basic Heat Exchanger Network Synthesis (HENS), Minimum Utility Targets, Temperature Interval Method, Hohmann / Lochart Composite Curves (HCC), Grand Composite Curves (GCC), Pinch Design Approach to Inventing a Network, Networks for Maximum Energy Recovery, Minimum Number of Exchangers, Stream Splitting, Threshold and Optimum Approach Temperature, Derivation of Network Superstructures for Minimization of Annual Costs, Multiple Utility Design Problems	22	37
4	Heat integration in distillation columns Heat Integrated Distillation Trains, Impact of Pressure, Multi Effect Distillation, Heat Pumping, Vapour Recompression and Reboiler Flashing, Positioning of Heat Engines and Heat Pumps	5	8
5	Separation Train Design Introduction, Phase Separation of Reactor Effluent, Criteria for Selection of Separation Methods, Selection of Equipment,	8	14



Approved Version from the Academic Year 2021-22



	Sequencing of Ordinary Distillation for the Separation of Nearly Ideal Fluid Mixtures, Heuristics for Determining Favourable Sequences, Marginal Vapour Rate Method, Complex and thermally coupled distillation, Sequencing of Ordinary Distillation for the Separation of Nearly Non-Ideal Fluid Mixtures		
6	Batch Scheduling Introduction, Design of Batch Process Units, Design of Reactor-Separator Processes, Design of Single Product Processing Sequences, Design of Multi-Product Processing Sequencing	6	12

Suggested Specification table with Marks (Theory/Practical):

% Distribution of Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	10	15	10	10	05

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

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.

Reference Text Books:

Sr. No.	Title of book /article	Author(s)	Publisher and details like ISBN	Year of publication	Publication Edition
1.	Product and Process Design Principles: Synthesis, Analysis, and Evaluation	Warren D. Seider, J. D. Seader, Daniel R. Lewin	Wiley ISBN: 9781119636984, 1119636981	2017 2009 2004 1999	4th Edition 3 rd edition 2 nd edition 1 st edition
2.	Chemical Process: Design and Integration	Robin Smith	Wiley ISBN- 9781118699089, 1118699084	2016	2 nd edition
3.	Systematic Methods of Chemical Process Design	Lorens T. Biegler, E. Ignacio grossmann, Arthur W. Westerberg	Prentice Hall International ISBN- 0134924223, 9780134924229	2007	-
4.	Conceptual Design of Chemical Processes	James M. Douglas	McGraw Hill International ISBN: 9780070177628, 0070177627	1988	-

Course Outcome:

Sr. No.	CO Statement After learning this subject, students will be able to	Marks % weightage
CO-1	Understand and explain the steps for product and process design and factors affecting.	15
CO-2	Develop reactor network using Attainable region concept.	15
CO-3	Synthesize network of heat exchangers for given hot and cold streams.	45
CO-4	Synthesize the sequence of separation operations for desired separation.	15
CO-5	Develop schedule for production of single and multi-product in any industry.	10





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Mapping with POs:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	P O1 0	PO 11	P O1 2	PS O1	PS O2	PS O3
CO-1	2	3	3	2	3	2	2	3	3	3	3	3	3	1	1
CO-2	3	2	2	2	3	2	3	3	3	3	3	3	2	2	1
CO-3	1	1	2	3	2	3	3	2	2	3	3	3	1	1	1
CO-4	2	2	3	2	2	2	3	3	3	3	3	3	2	2	3
CO-5	3	2	3	2	3	3	2	3	2	3	3	3	3	3	3
Rationale*	11	10	13	11	13	12	13	14	13	15	15	15	11	14	9

Rationale*: Explaining why it is matching this particular program outcome

LIST OF PRACTICALS: (Minimum 10 to be performed.)

SrNo	Experiment
1	Steps for product and process design
2	Attainable region for van de Vusse reaction mechanism for PFR
3	Attainable region for van de Vusse reaction mechanism for CSTR
4.	Attainable region for van de Vusse reaction mechanism for Reactor Network
5.	Minimum utility targets using Temperature Interval Method, Graphical Method and Linear Programming
6.	Heat Exchanger Network design using pinch design approach
7.	Concept for Maximum Energy Recovery & Minimum Number of Heat exchanger
8.	Concept of Minimum and Thresold Approach temperature difference
9.	Marginal Vapor Rate method for Distillation train design
10.	Batch scheduling – single product processing sequence
11.	Batch scheduling – multi product processing sequence
12.	Heat integrated distillation train
13.	Positioning of heat pump and heat engine in HEN

Major Equipment:

1. Computers with specifications compatible to run the softwares.

List of Open Source/learning website:

<https://nptel.ac.in/courses/103/107/103107096/> : web course on Process Medeling and Simulation by Dr. V. K. Agrawal, IIT Roorkee.

www.scilab.in (free literature for solution of books for chemical engineering)

List of Open Source Software:: Computer with software i.e. MS Excel, Scilab, Python, DWSIM, ChemCAD/ASPEN one etc.

