

GUJARAT TECHNOLOGICAL UNIVERSITY

CHEMICAL ENGINEERING (COMPUTER AIDED PROCESS DESIGN) (16)

ENERGY & MASS INTEGRATION (EMI)

SUBJECT CODE: 2711606

SEMESTER: I

Type of course: Major Elective-I (M.E.CAPD)

Prerequisite: --

Rationale: --

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P		Theory Marks		Practical Marks				
			ESE (E)	PA (M)	PA (V)		PA (I)			
					ESE	OEP	PA	RP		
3	2	0	4	70	30	30	0	20	0	150

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	Heat and Power Integration: Introduction, basic heat exchanger network synthesis (HENS), Hohmann / Lochart Composite Curves, Grand Composite Curve(GCC), pinch design approach to inventing a network, Picking the right minimum temperature driving force ΔT_{MIN} .	10	20
2	Synthesis of Heat Exchanger Networks : Minimum utility cost, maximum energy recovery, minimum number of exchanger, threshold and optimum approach temperature, derivation of network structures for minimization of annual costs, , Multiple utility design problems.	09	15
3	Optimization and Heat Integration: Sequential and Simultaneous approaches of Optimization and Integration, Simultaneous MINLP model for optimization, Application, Problems and Examples – Crude Heat Pre-train, Aromatics Plants, Evaporator / Dryer Plant.	9	15
4	Refrigeration Cycles: Design of refrigeration cycles, Grand Composite Curves to design refrigeration cycles, optimization of refrigeration cycle design.	9	15
5	Energy Integrated Distillation Processes: Heat flows in distillation, T-Q Diagram, Interheating / Intercooling, Thermal condition of feed, Heat flows in side strippers and side enriches Heat integrated distillation trains, impact of pressure, multi effect distillation, Heat Pumping Vapour Recompression and Reboiler Flashing, Heat engine and Heat Pumps optimization.	9	20
6	Mass Integration: Introduction, minimum Mass Separating Agent (MSA), mass exchanger networks minimum external MSA, minimum number of mass exchangers.	8	15

Reference Books:

1. Systematic Methods of Chemical Process Design Lorenz T. Biegler , E. Ignacio Grossmann, Arthur W Westerberg Published by-Prentice Hall International, Inc.
2. Product and Process Design Principles Warren D Seider, J. D. Seader, Daniel R Lewin Published by John Wiley and Sons, Inc.
3. User Guide on Process Integration for the efficient use of energy B Linnhoff IChE (UK) .

Course Outcome:

After learning the course the students should be able to:

1. Learn the basic heat exchanger network synthesis (HENS).
2. Develop the pinch design approach to inventing a network.
3. Study the derivation of network structures for minimization of annual costs.
4. Configure the multiple utility design problems.
5. Learn the Sequential and Simultaneous approaches of Optimization and Integration.
6. Design the refrigeration cycles.
7. Understand the Energy Integrated Distillation Processes.
8. Study about Mass Integration

List of Experiments:

Tutorials/Presentation/Practicals based on above topics.

Major Equipments:

Distillation Apparatus, Temperature Control Trainer etc.

List of Open Source Software/learning website:

- www.sciencedirect.com/science/article/pii/S1874597006800111
- www.eng.auth.gr/~chemtech/.../mar08_martin_hint%20program.pdf
- www.academia.edu/.../Application_for_pinch_design_of_heat_exchange.
- www.nt.ntnu.no/users/skoge/prost/.../distillation06/CD.../paper015.pdf
- www.linkedin.com/title/mass+integration+engineer/