

NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

This course outline template acts as a guide for writing your course outline. As every course is different, please feel free to amend the template/ format to suit your requirements.

COURSE OUTLINE TEMPLATE						
Course Title	Advanced Separation Techniques					
Course Code	CL 610	No. of Credits	L	T	P	C
			3	0	0	3
Department	Chemical Engineering	Faculty	K.M.Meera Sheriffa Begum			
Pre-requisites Course Code	Knowledge in Equilibrium staged mass transfer separation processes.					
Course Coordinator(s) (if, applicable)	Dr.K.M.Meera Sheriffa Begum					
Other Course Teacher(s)/Tutor(s) E-mail	-	Telephone No.	0431-2503109			
Course Type	Elective course					
COURSE OVERVIEW						
<p>This course gives an insight into concepts of rate governed separation techniques and applications of less energy intensive processes for down streaming operations. Outcome of this course will enable a student to apply the methodologies for various industrial down streaming and bio- process applications.</p>						
COURSE OBJECTIVES						
<ol style="list-style-type: none"> 1. To learn the principle and technical concepts of rate governed separation processes. 2. To understand the less energy intensive processes for down streaming applications. 3. To apply the knowledge in designing process equipments. 						
COURSE OUTCOMES (CO)						
Course Outcomes			Aligned Programme Outcomes (PO)			
1. COURSE OUTCOME						
Upon completing the course, the student will be able to						
1. have awareness about conventional and non-conventional separation processes			PO1 , PO2			
2. acquire sufficient knowledge in less energy intensive processes for separation of components.			PO1, PO2, PO4, PO6, PO8, PO9 and PO10			
3. apply the methodologies for various industrial down streaming and bio- process applications.			PO1, PO2,PO3, PO4, PO5, PO6, PO7, PO9, PO10 and PO11			
4. analyze the design constraints of process equipments in industrial applications			PO1, PO2, PO3, PO5, PO9 and PO11			

COURSE TEACHING AND LEARNING ACTIVITIES (* : It is likely that some of the classes will be lost due to holidays and hence the semester will go upto 14 weeks)

S.No.	Week	Topic	Mode of Delivery
1.	Week 1	Overview of equilibrium separation processes	PPT
2.	Week 1	Review of separation equipments, Cascade theory	Chalk and talk
3.	Week 1	Rate governed separation processes - advantages	Chalk and talk
4.	Week 2	Pressure gradient separations-principle and advantageous features	Chalk and talk
5.	Week 2	Membrane-Types, classification, preparation and characterization	Chalk and talk
6.	Week 2	Concentration polarization theory - factors for membrane flux	Chalk and talk
7.	Week 3	Membrane modules-Types, description, operative features	PPT
8.	Week 3	Design factors, Modes of operations and fouling preventive measures	Chalk and talk
9.	Week 3	Membrane processes and their applications - MF, UF,RO, pervaporation, Dialysis, Materials, operation	Chalk and talk
10.	Week 4	Gas Permeation- principle, permeators, membranes, design factors	Chalk and talk
11.	Week 4	Sorption separation- Principle of chromatography and ion exchange, Retention theory	Chalk and talk
12.	Week 4	Resolution- band broadening factors -design controlling factors	Chalk and talk
13.	Week 5	Types of chromatographic techniques- Principles and their applications, Detectors	Chalk and talk/PPT
14.	Week 5	Band Broadening –Causing factors – preventive measures	Chalk and talk
15.	Week 5	Scaleup problems in chromatography	Chalk and talk
		Test - I	
16.	Week 6	Dialyser types, membranes, design, applications	Seminar/PPT
17.	Week 6	Plasma membranes for Hydrogen production Enzymatic Membranes for biological applications	Seminar/PPT
18.	Week 6	Affinity and Gel permeation chromatography- Biological applications	Seminar/PPT
19.	Week 6 (Extra Hr)	Super critical fluid and Chiral chromatography	Seminar/PPT

20.	Week 7	Ionic separations- Electrolytic principle, advantages	Chalk and talk
21.	Week 7	Electrolytic stack operation and design factors	Chalk and talk
22.	Week 7	Industrial applications-Technical problems in electrolytic operations	Chalk and talk
23.	Week 7(Extra Hr)	Variants of electro-membranes -modes of ED operations	Chalk and talk
24.	Week 8	Sweetening of fruit juice by ionic replacement	Seminar/PPT
25.	Week 8	Radioactive strontium removal from milk by ED	Seminar/PPT
26.	Week 8	Electro kinetic methods – Principle and advantages	Chalk and talk
27.	Week 8(Extra Hr)	Electrokinetic principles-electro-osmosis, Stern theory, Zeta potential, Electrophoretic mobility Factors	Chalk and talk
28.	Week 9	Capillary, Moving boundary, Zone electrophoresis-applications	Chalk and talk
29.	Week 9	Gel electrophoresis-principle, method and biomedical applications	Seminar/PPT
30.	Week 9	Dielectrophoresis- Mechanism and applications	Seminar/Chalk and talk
31.	Week 9(Extra Hr)	Thermal gradient separation processes-TD and zone melting-principle	Chalk and talk
		Test - II	
32.	Week 10	Thermal diffusion flux equations –phase diagrams	Chalk and talk
33.	Week 10	Thermal diffusion equipments- design factors	Seminar/PPT
34.	Week 10	Isotopic separations by TD for Nuclear industry	Seminar/PPT
35.	Week 10(Extra Hr)	Zone melting- types- phase diagrams, Types of zone heaters	Chalk and talk
36.	Week 11	Arc Zone melting in Metallurgical industries	Seminar/PPT
37.	Week 11	Temperature gradient Zone refining in semiconductor Industry	Seminar/PPT
38.	Week 11	Floating Zone melting, vapor zone refining for organic compounds	Seminar/PPT
39.	Week 11(Extra Hr)	Foam separation, Adductive crystallization - Principle, theory and advantages	Chalk and talk
		Retest	
40.	Week 12	Foam structure, Foaming agents-stability and drainage factors –thermodynamic equilibrium,	Chalk and talk

41.	Week 12	Equipments , Foam fractionation in Protein separation	Seminar/PPT
42.	Week 12	Isomers separation by Adducts, Design Factors	Seminar/PPT
		Semester Examination	

COURSE ASSESSMENT METHODS

S.No.	Mode of Assessment	Week/Date	Duration	% Weightage
1	I cycle test	6 th week since commencement	1 hour	20%
2	Seminar-1	6 -9 th week	-	5%
3	II cycle test	10 th week since commencement	1 hour	20%
4	Seminar -2	10 -12 th week	-	5%
5	Retest*	12 th week since commencement	1 hour	20%
6	End semester examination	At the end of Course	3 hours	50%

*(Only for Absentees in any one of the cycle tests)

ESSENTIAL READINGS : Textbooks, reference books Website addresses, journals, etc

Text Books :

1. H.M. Schoen, *New Chemical Engineering Separation Techniques*, Wiley Interscience, New York, 1972.
2. B. Sivasankar, *Bioseparations – Principles and Techniques*, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
3. KaushikNath, *Membrane Separation processes*, PHI, New Delhi 2008.

Reference Books:

1. J.D. Seader, Ernest J.Henley and D. Keith Roper, *Separation Process Principles*, 3rd edition, John Wiley & Sons Australia, Limited, 2010.
2. M. Mulder, *Basic Principles of Membrane Technology*, Kluwer Academic Publishers, London, 1996.
3. Ronald W.Roussel, *Hand book of Separation Process Technology*, John Wiley, New York, 1987.

COURSE EXIT SURVEY (mention the ways in which the feedback about the course is assessed and indicate the attainment also)

- 1) Feed back is planned to be collected twice; once in the mid semester and one at the end of course as soon as classes are over.
- 2) The academic performance of the students will be assessed based on 2 cycle tests (each 20 marks), one final examination (50 marks) and seminars (10 marks).
- 3) Suitable mapping of COs with POs will be made and attainment will be calculated.

COURSE POLICY (including plagiarism, academic honesty, attendance, etc.)

- 1) It is expected that the students will not indulge in any form of malpractice in Examinations. Seminar presentation will focus on the emerging trends.
- 2) Attendance of 75% and above is expected. The 25% allowance is given for absence due to illness/institute related activities(sports/competitions/seminars etc)

ADDITIONAL COURSE INFORMATION

eg.: The Course Coordinator is available for consultation at times that are displayed on the coordinator's office notice board. Queries may also be emailed to the Course Coordinator directly at **meera@nitt.edu**

FOR SENATE'S CONSIDERATION

Approved by:

Course Faculty : K.M.Meera S. Begum **CC-Chairperson :** N.Samsudeen

HOD : P.Sivashanmugam