DEPARTMENT OF CHEMICAL ENGINEERING

NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

COURSE PLAN – PART I			
Name of the programme and specialization	**B.Tech. (Chemical Engineering)**		
Course Title	**Mass Transfer**		
Course Code	CLPC20	**No. of Credits**	3
Course Code of Pre-requisite subject(s)	CLPC15 - Process Calculations		
Session	**July 2018**	**Section (if, applicable)**	**V Semester**
Name of Faculty	**Dr.T.Sivasankar**	**Department**	Chemical Engineering
Email	ssankar@nitt.edu	**Telephone No.**	0431-2503131
Name of Course Coordinator(s) (if, applicable)			
E-mail		**Telephone No.**	
Course Type	√ **Core course**	☐ **Elective course**	

Syllabus (approved in BoS)

Definition, Ficks law, Molecular and eddy diffusion, Diffusion in gaseous mixtures, liquid mixtures and solids, Types of solid diffusion, Pseudo steady state diffusion, measurement and calculation of diffusivities. Ordinary diffusion in multicomponent gaseous mixtures. Unsteady state Diffusion.

Equilibria, Mass transfer coefficients - Individual and overall with relations, Theories of mass transfer, Analogies between momentum, heat and mass transfer to predict mass transfer coefficients.

Absorption – Solubility, theory of gas absorption, Design of absorption towers, Concept of Equilibrium and operating lines. Mass Transfer Equipments-Batch and continuous Stage wise contactors and Differential contactors, Concept of HTU and NTU, Tower packings and packing characteristics, Non-isothermal absorbers, Case studies in absorption with chemical reactions.

Humidification Theory, Psychometric Chart, Adiabatic Saturator, Wet Bulb Theory, Methods of Humidification and dehumidification, Cooling tower theory, Design of cooling towers, Industrial cooling towers, Air conditioning process, Recirculating water gas humidification system.

Drying Theory and Mechanism, Drying Characteristics, Estimation of Drying time, drying rate curve, Classification of Driers, Through circulation driers design, Design of driers, Description and Application of Driers, Analysis of continuous driers.

Crystallization Theory, Solubility curve, Types of crystals, Principles of Crystallization, Supersaturation Theory, Factors governing nucleation and crystal growth. Theory of crystallization, Classification of crystallizers and their applications. Product size distribution by MSMPR model. Industrial crystallizers, Crystallizer Design.

Textbooks, reference books:

1. *R.E. Treybal, "Mass Transfer Operations", 3rd Edn., McGraw Hill Book Co., New York, 1981.*
2. *N. Anantharaman and K.M.Meera Sheriffa Begum, "Mass Transfer Theory and Practice", Printice Hall of India Pvt. Ltd., New Delhi, 2013.*
3. *A.S.Foust, "Principles of Unit Operations", 2nd Edition, Wiley & Sons, New York, 1980.*
4. *J. M. Coulson and J. F. Richardson, "Chemical Engineering", 5th Edition Vol. II, P Butterworth Heinemann, New, 2002.*
5. *C.J.Geankoplis, "Transport Processes and Separation Process Principles," IV edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2004.*
6. *W.L. McCabe, J.C. Smith and P. Harriot, "Unit Operations of Chemical Engineering", 7th Edn., McGraw Hill Book Co., New York, 2004.*

COURSE OBJECTIVES

1. To learn the concept of diffusion in gas, liquid & solid.
2. To understand the basics of interphase mass transfer.
3. To learn application of gas-liquid operation and simultaneous heat and mass transfer operations.

COURSE OUTCOMES (CO)

Course Outcomes	**Aligned Programme Outcomes (PO)**
1. Will be familiar with the basic phenomenon of mass transfer involving phases. 2. Will be able to apply the mathematical and design concepts of mass transfer in gas-liquid systems like absorption, humidification, drying and crystallization. 3. Will be gaining good knowledge of required optimum condition for a gas-liquid system.	PO2, PO3, PO5, PO11, PO12

COURSE PLAN – PART II

COURSE OVERVIEW

This course will provide the required basics of molecular mass transfer that will be happening in most of the chemical engineering unit operations. Diffusion is the basic phenomena lying in this process. The basic theories behind these diffusion and the analogies between heat, momentum and mass tranfer would be dealt with. The mass transfer that occurs in gas/liquid/solid-gas/liquid systems would be elaborated. The design of major columns like adsorption, humidification, drying and crystallization based on the mass tranfer concepts would be elaborated.

COURSE TEACHING AND LEARNING ACTIVITIES

Sl.No.	Week	Topic	Mode of Delivery
1.	Week 1	Basics of Mass Transfer (MT), Various MT operations & their application in chemical engineering.	Chalk and Talk / PPT
2.	Week 2	Equilibrium basis in MT, Molecular Diffusion, Interphase MT.	Chalk and Talk / PPT
3.	Week 3	Fick's Law of diffusion, Binary, Eddy, Steady state, Pseudo molecular diffusion for gases, Multicomponent diffusion	Chalk and Talk / PPT
4.	Week 4	Diffusion in liquids & solids, diffusion predictions, Unsteady state diffusion	Chalk and Talk / PPT
5.	Week 5	MT coefficients, Theories of MT	Chalk and Talk / PPT
6.	Week 6	Dimensional analysis, Analogies between heat, momentum & heat transfer	Chalk and Talk / PPT
7.	Week 7	G-L phase controlled systems, Individual & overall MT coefficients	Chalk and Talk / PPT
8.	Week 8	Gas Absorption: Columns-Types, factors affecting the operation, Equilibrium	Chalk and Talk / PPT
9.	Week 9	Operating line (OL) for counter current/co-current absorber & stripper plate column, L/G ratios, No. of columns and Height	Chalk and Talk / PPT
10.	Week 10	OL for counter current/co-current absorber & stripper packed column, L/G ratios, HETP	Chalk and Talk / PPT
11.	Week 11	Humidification: Basics definitions, wet bulb theory	Chalk and Talk / PPT
12.	Week 12	Cooling towers: Types, OL & Height of the humidifiers and dehumidifiers	Chalk and Talk / PPT
13.	Week 13	Drying: Equilibrium, Hysteresis, types of dryers, drying behavior.	Chalk and Talk / PPT
14.	Week 14	Falling rate & constant rate period. Crystallization: Crystal growth, solubility curves, equilibrium, HT & MT	Chalk and Talk / PPT
15.	Week 15	Nucleation, crystallization equipment, MSMPR crystallization model	Chalk and Talk / PPT

COURSE ASSESSMENT METHODS (shall range from 4 to 6)

S.No.	Mode of Assessment	Week/Date	Duration	% Weightage
1	Assessment – 1 (written)	Week 6	1 hr	20
2	Assessment – 2 (written)	Week 12	1 hr	20
3	Assessment – 3 (three online Quiz)	Will be conducted upon sufficient portion coverage	--	30
CPA	Compensation Assessment*	Week 14	1 hr	20
4	Final Assessment * (Written)	Week 16	2 hrs	30

***mandatory; refer to guidelines on page 4**

COURSE EXIT SURVEY (mention the ways in which the feedback about the course shall be assessed)

Course Exit survey will be collected at the end of the semester before the start of semester examination through online. Students can log in their MIS account to give the feedback. Mid semester feedback will also be obtained for the effective teaching learning process.

COURSE POLICY (preferred mode of correspondence with students, compensation assessment policy to be specified)

MODE OF CORRESPONDENCE (email/ phone etc)

Queries may also be emailed to the Course Coordinator directly at **ssankar@nitt.edu**

COMPENSATION ASSESSMENT POLICY

- If the student misses (due to valid reason) either Assessment-1 or Assessment-2, he/she will be given an option to appear for Re-assessment which covers the portion of the two assessment.
- There will be no compensatory re-assessment for Assessment – 3 on any grounds.

ATTENDANCE POLICY (A uniform attendance policy as specified below shall be followed)

- **At least 75% attendance in each course is mandatory.**
- **A maximum of 10% shall be allowed under On Duty (OD) category.**
- Students with **less than 65% of attendance** shall be prevented from writing the final assessment and **shall be awarded 'V' grade.**

ACADEMIC DISHONESTY & PLAGIARISM

- Possessing a mobile phone, carrying bits of paper, talking to other students, copying from others during an assessment will be treated as punishable dishonesty.
- Zero mark to be awarded for the offenders. For copying from another student, both students get the same penalty of zero mark.
- The departmental disciplinary committee including the course faculty member, PAC chairperson and the HoD, as members shall verify the facts of the malpractice and award the punishment if the student is found guilty. The report shall be submitted to the Academic office.

  The above policy against academic dishonesty shall be applicable for all the programmes.

ADDITIONAL INFORMATION

FOR APPROVAL

Course Faculty 24/07/18 **CC-Chairperson** _____ **HOD** _____