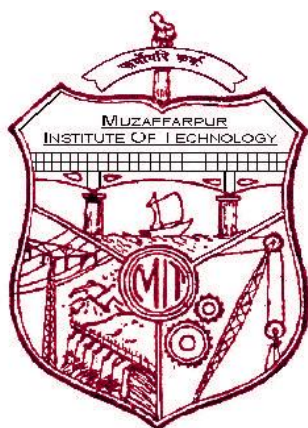# MIT MUZAFFARPUR

COURSE FILEOF

Chemical Engineering-2

(071505)

Faculty Name:

MITHILESH KUMAR RAI

ASSISTANT PROFESSOR,DEPARTMENT OF LEATHER TECHNOLOGY

Content

VISION STATEMENT

- To emerge as a national leader in graduate level studies in all sub areas of leather field and to make significant contribution to the development of the society, industry, nation and the world.

MISSION STATEMENT

- Educate leather technology students to produce quality engineers who serve leading firms and different sectors of the industry and can work in multi-disciplinary environment to anticipate and address evolving challenges of the 21st century in tanning and footwear industry.
- Impart high performance knowledge in leather and footwear sector that are economic and environment friendly.
- To establish national leadership and provide technological support to the Indian leather industry.
- Improve fundamental knowledge of inter relationship between the built environment and natural systems.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

After successful completion of program, graduates will be able to

PEO1: Work in the leather, chemical and footwear industries.

PEO2: Pursue higher studies.

PEO3: Contribute in teaching, research and other developmental activities of Leather technology and its allied fields.

PEO4: Work in the multicultural and multidisciplinary groups for the sustainable development and growth of leather industry projects and profession.

PROGRAMME OUTCOMES (PO)

Students who complete the B.E. degree in leather technology will be able to:

1. An ability to apply knowledge of mathematics, science, and engineering,

2. The ability to conduct laboratory experiments and to critically analyze and interpret experimental data.

3. The ability to perform design of leather products by means of design experiences integrated throughout the professional component of the curriculum.

4. An ability to function on teams, that must integrate contributions from different areas of leather technology towards the solution of multi-disciplinary projects.

5. An ability to identify, formulate, and solve Leather technology problems.

6. An understanding of professional practice issues in leather technology including professional and ethical responsibility.

7. An ability to write and speak effectively.

8. The broad education necessary to understand the impact of leather technology solutions in a global and societal context.

9. A recognition of the need for, and an ability to engage in life-long learning,

10. An ability to use the techniques, skills, and modern tools necessary for leather technology practices.

11. Possess a thorough understanding of techniques that are appropriate to environment and country.

12. Possess ability to estimate costs, estimate quantities and evaluate materials for leather manufacturing.

COURSE OBJECTIVE AND COURSE OUTCOMES:

Institute / College Name :	MUZAFFARPUR INSTITUTE OF TECHNOLOGY		
Program Name	B. Tech.Leather Technology		
COURSE CODE	071505		
COURSE NAME	Chemical Engg-2		
Lecture / Tutorial / Practical (per week):	3 – 0- 3	Course Credits	4
Course Coordinator Name	MITHILESH KUMAR RAI		

Course objective:

The objective of this course is to provide the fundamental concepts associated with the mass transfer operation like adsorption, absorption, crystallization. To introduce the basic concept of Theory of crystallization, crystallization equipment for chemical as wells as leather industry. To give knowledge about diffusion and mechanism of mass transfer operation by different theory. To give knowledge about adsorption and absorption operation and application of it in leather industry.

Course outcomes (CO):

CO1: Became familiar with different chemical reactions which are used in leather industry.

CO2: Learn the mechanism of diffusion and theory of mass transfer operation.

CO3: Understand the mechanism of crystallization and crystallization equipment for chemical processing.

CO4: Became able to know the mechanism of adsorption and absorption and use of these operations in leather industry.

MAPPING OF COs AND POs

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓		✓								
CO2		✓	✓	✓								
CO3	✓		✓	✓	✓							
CO4	✓	✓	✓		✓							

Correlation level: 1- slight (Low)   2- moderate (Medium)   3-substantial (High)

COURSE SYLLABUS:

Topics	Number of Lectures	Weightage (%)
Nitration, Alkylation, Halogenation, Slufonation	10	23
Crystallization :- Theory of crystallization, crystallization equipment for chemical processing	8	18
Adsorption :- Theory of adsorption, Industrial adsorbents adsorption equipments Decolourization of chemicals	8	18
Diffusion :- Binary diffusion Concept of mass transfer coefficients and interface mass transfer and stage wise contact	9	18
Absorption :- Theory of gas absorption, Design and operation of absorption towers, Humidity and its measurements.	8	21

Adiabatic Saturation temp. Dry and wet bulb temp, Humidity chart.		

Practical

Topics	Number of week	Weightage (%)
To find out the Viscosity of a given fluid by ostwald Viscometer and by capillary tube viscometer	1	20
To study about bomb calorimeter	1	20
To find the calorific value of a given solid fuel	1	20
To separate the mixture of Benzene and Toluene by simple distillation method	2	20
Screen analysis by Taylor's method	1	20

MUZAFFARPUR INSTITUTE OF TECHNOLOGY
B.Tech. 5th Semester (2016 Batch) PROVISIONAL TIME TABLE

	4thSEMESTER Leather technology					ROOM NO. LB-2		
	9:00 - 10:00	10:00 - 11:00	11:00- 12:00	12:00 – 1:00	1:00 – 2:00	2:00- 3:00	3:00 - 4:00	4:00 – 5:00
MON					R	CH ENGG-1I(MKR) (Test)		
TUES					E			
WED	CH ENGG-1I(MKR)				C			
THUR	CH ENGG-1I(MKR)				E			
FRI	CH ENGG-1I(MKR)				S	CH ENGG-1I(MKR) (Lab)		
SAT					S			

FACULTY NAME:MKR: MITHILESH KUMAR RAI

STUDENT LIST:

Sl. No.	College Roll No.	AKU Reg. No.	Name
1	16LT08	16107107001	ARCHANA KUMARI
2	16LT20	16107107003	RAVINDRA RAM
3	16LT15	16107107004	SURBHI SAURAV
4	16LT11	16107107005	AMAN SHRIVASTAVA
5	16LT05	16107107007	VIKASH KUMAR
6	16LT19	16107107008	DEEPSHI
7	16LT16	16107107009	RAKESH KUMAR SAH
8	16LT14	16107107010	RAKESH KUMAR
9	16LT17	16107107011	KRITIKA VAGMI

Text Books:

TB1: Mass transfer operation by Robert E. Trebal
TB2: Principle of Mass Transfer & Separation Process by B.k Dutta
TB3: Mass transfer operation by K.A Gavani
TB4: Unit operation of chemical Engineering by Mc cabe and Smith

COURSE PLAN

Topic No.	Topic	No. of Lecture/ lecture no.	Text book
1.	**Chemical reaction**	**10**	**TB1, TB2**
	Nitration	1-2	
	Alkylation	3-5	
	Halogenation	5-7	
	Slufonation	8-10	
2.	**Crystallization**	**8**	**TB1, TB2**
	Theory of crystallization	11-14	
	crystallization equipment for chemical processing	15-18	
3	**Adsorption**	**8**	**TB1, TB2**
	Theory of adsorption	19-23	
	Industrial adsorbents adsorption equipments	24-25	
	Decolourization of chemicals	26-26	
4	**Diffusion**	**9**	**TB1, TB2**
	Binary diffusion Concept of mass transfer	27-31	
	coefficients and interface mass transfer and stage wise contact	32-35	

5	**Absorption**	**8**	**TB1, TB2**
	Theory of gas absorption	36-37	
	Design and operation of absorption towers	38-39	
	Humidity and its measurements	40-41	
	Adiabatic Saturation temp	42-42	
	Dry and wet bulb temp ,Humidity chart	43-43	
	Total Lectures	**43**	
Total Number of Lecture		43	

DETAILS OF ASSIGNMENTS:

S.No.	Assignment	Topic No.
1	Assignment 1	1
2	Assignment 2	2
3	Assignment 3	3
4	Assignment 4	4,5

Chemical Engineering -1 (071505)

Assignment -1

Q.1 What do you mean by nitration. Write down the mechanism of nitration.

Q.2 Write down the mechanism of salfonation.

Q.3 Write down the mechanism of alkylation and its use in leather industry.

Chemical Engineering -1 (071505)

Assignment -2

Q.1 Explain the term super saturation. Why super saturation is useful in crystallization?

Q.2 Explain the continues and batch crystallizer. Write down the working principle of continues type of crystallizer with diagram.

Chemical Engineering -1 (071505)

Assignment -3

Q.1 Write down the theory of adsorption. Explain the characteristics of adsorbent.

Q.2 Write the difference between Physical and chemical adsorption**.**

Q.3 Describe different adsorption isotherms.

Chemical Engineering -1 (071505)

Assignment -4

Q.1 What is fix law of diffusion in mass transfer operation.

Q.2 Write down the different type of mass transfer coefficient.

Q.3 What is wet bulb temperature.

Q.4 Write the working principle of packed bed adsorption with digram.

Question bank;

Code : 071505

B.Tech(Leather Technology) 5th Semester Examination, 2016

Chemical Engineering-II

Time : 3 hours   Full Marks : 70

Instructions :

(i)   *There are Nine Questions in this Paper.*

(ii)   *Attempt Five questions in all.*

(iii)   *Question No. 1 is Compulsory.*

(iv)   *The marks are indicated in the right hand margin.*

1. Answer any seven of the following: $2 \times 7 = 14$

    (a) Write a short note on alkylation.

    (b) Define supersaturation.

    (c) What is nucleation ?

    (d) Define freundlich adsorption isotherms.

    (e) What is Magma?

    (f) What is chemisorptions?

    (g) What is diffusivity of liquid?

    (h) Define absorption factor.

    (i) Define absolute humidity.

    (j) What is the relation between the diffusivity (D) and the temperature (T) for a binary gas mixture?

                                                       P.T.O.

2. (a) Define humid volume.

    2

   (b) Write short notes on any four of the following: $3\times4=12$

     (i) Halogenation

     (ii) Nitration

     (iii) Sulfonation

     (iv) Dew point

     (v) Henry's law

     (vi) Wet bulb temperature

3. (a) What are the various theories for mass transfer?   4

   (b) Oxygen (A) is diffusing through carbon monoxide(B) under steady-state conditions with carbon monoxide non-diffusing the total pressure is 760 mm Hg and the temperature is 0°C the partial pressures of oxygen at two planes 0.2 cm apart are 100 mm and 50 mm Hg respectively. The diffusivity of the mixture is 0.185 cm²/ sec. Calculate the rate of diffusion of oxygen in gm moles/ sec. through each square centimeter of the two planes.

    Given Universal gas constant   10   •

        R=82.6 cm³.atm/(gm-mole)K

4. Experiments on decolourization of oil yielded the following equilibrium relationship:

$$y = 0.5x^{0.5}$$

   Where y = g colour removed/g adsorbent

Code: 71505   2

and x = colour in oil, g colour /1000 g colour. free oil. 100 kg oil containing 1 part of colour to 3 parts of oil is agitated with 25 kg of absorbent. Calculate the % colour removed, if (a) all 25 kg of adsorbent is used in one step and (b) 12.5 kg of adsorbent is used initially followed by another 12.5 kg of adsorbent. 7+7=14

5. (a) What is molecular diffusion in gases? 4

(b) Calculate the rate of diffusion of acetic acid (A) across a film of non-diffusing water (B) 1 mm thick at 17°C when the concentration on opposite sides of the film are respectively. 9 and 3 wt % acid. the diffusivity of acetic acid in the solution is 0.95×10^{-9} m²/sec.

At 17°C, the density of 9% solution is 1012 kg/m³

At 17°C, the density of 3% solution is 1003.2 kg/m³

10

6. (a) What are the characteristics of adsorbent ? 4

(b) Write briefly about single stage adsorption and multistage Counter current adsorption discussing the application of Freuradlich equation for each stage. 10

7. (a) Write about flooding, loading and liquid holdup during operation of a packed absorption tower. 6

(b) It is desired to adsorb acetone from a dilute mixture of acetone/air containing 1 mol % acetone by contacting

Code : 071505   3   P.T.O.

it counter-currently with pure water in an absorber consisting of two theoretical stages. The total inlet gas flow rate is 30 k mole/hr and that of water is 90 K mole/hr. under the operating conditions .The equilibrium relationship for acetone in gas-liquid is $y = 2x$. Estimate the mole fraction of acetone in the water stream leaving the observer. 8

8. (a) Discuss briefly about Vacuum crystalliser. 7

   (b) Write briefly about Draft tube-baffle Crystalliser. 7

9. (a) Discuss about Mechanism of crystallisation. 4

   (b) A hot solution containing 200 kg of $MgSO_4$ and water at 330 K and with a concentration of 30 wt % $MgSO_4$ is cooled to 293K and $Mg\,SO_4 \cdot 7H_2O$ crystals are removed. The solubility at 293 K is 35.5 kg $MgSO_4$ per 100 kg water. Calculate the yield of crystals assume that no water is evaporated. 10

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Result of the students

Roll No	Name	Marks of attendance	Class test	End semester exam	Total	Marks of attendance	Class performance	viva voice	Total