



GUJARAT TECHNOLOGICAL UNIVERSITY

BACHELOR OF ENGINEERING SYLLABUS

Subject Code : 3145104

Subject Name : Unit Operations in Food Engineering

WEF Academic Year :	2022-23
Semester :	4
Category of the Course :	Professional Core

Prerequisite : Nil

Course Scheme :

Teaching Scheme			Total Credits	Assessment Pattern and Marks				Total Marks
L	T	PR	C	Theory		Practical		
				ESE (E)	PA(M)	ESE (V)	PA (I)	
4	0	2	5	70	30	30	20	150

Course Content :

Sr. No.	Course Content	No. of Hours
1	EVAPORATION AND CONCENTRATION Unit operations in food processing –conservation of mass and energy – overall view of an engineering process-dimensions and units – dimensional and unit consistency – dimensionless ratios-evaporation – definition – liquid characteristics – single and multiple effect evaporation- performance of evaporators and boiling point elevation – capacity – economy and heat balance- types of evaporators – once through and circulation evaporators – short tube evaporators and long tube evaporators – agitated film evaporator.	8
2	MECHANICAL SEPARATION Filtration – definition –filter media – types and requirements-constant rate filtration – constant pressure filtration – filter cake resistance-filtration equipment – rotary vacuum filter – filter press- sedimentation – gravitational sedimentation of particles in a fluid – Stoke’s law, sedimentation of particles in gas-cyclones – settling under sedimentation and gravitational sedimentation-centrifugal separations – rate of separations – liquid – liquid separation – centrifuge equipment- Membrane technology-types and applications.	10
3	SIZE REDUCTION Size reduction – grinding and cutting – principles of comminuting – characteristics of comminuted products – particle size distribution in comminuted products-energy and power requirements in comminuting – crushing efficiency – Rittinger’s, Bond’s and Kick’s laws for crushing-size reduction equipments – crushers – jaw crusher, gyratory crusher-crushing rolls – grinders – hammer mills – rolling compression mills – attrition, rod, ball and tube mills – construction and operation.	8



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4	CONTACT EQUILIBRIUM SEPARATION Contact equilibrium separation processes – concentrations – gas-liquid and solid-liquid equilibrium – equilibrium concentration relationships – operating conditions-calculation of separation in contact – equilibrium processes-gas absorption – rate of gas absorption – stage – equilibrium gas – absorption equipment-properties of tower packing – types – construction – flow through packed towers-extraction – rate of extraction – stage equilibrium extraction-equipment for leaching coarse solids – intermediate solids – basket extractor-extraction of fine material – Dorr agitator - continuous leaching – decantation systems – extraction towers-washing – equipments.	10
5	CRYSTALLIZATION AND DISTILLATION Crystallization – equilibrium -solubility and equilibrium diagram – rate of crystal growth – equilibrium crystallization-crystallization equipment – classification – construction and operation- tank, agitated batch, Swenson-Walker vacuum crystallizers-distillation – binary mixtures – flash and differential distillationsteam distillation – theory – consumption – continuous distillation with rectification – vacuum distillation - batch distillation – operation and process – advantages and limitations-distillation equipments – construction and operation – factors influencing the operation.	12

Reference Book :

1. Geankoplis, C.J. –Transport Processes and Separation Process Principles||, 4th Edition, Prentice Hall, 2003.
2. McCabe W.L., Smith J.C. –Unit Operations in Chemical Engineering||, 7th Edition, McGraw – Hill Int., 2001,
3. Earle, R.L. 2003. Unit Operations in Food Processing. Pergamon Press. Oxford. U.K.
4. Geankoplis C.J.1999. Transport Process and Unit Operations. Prentice-Hall of India Private Limited, New Delhi.

Course Outcome : After Completion of the Course, Student will able to :

No.	Course Outcomes
01	Understand Principles of separation methods used in the process industry.
02	Gain the knowledge on different equipments developed for separation.
03	Acquire the concept of crystallization and distillation



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Suggested Course Practical List :

1. Flow measurement a) Orifice meter b) Venturi meter, c) Rotameter
2. Determination of economy and thermal efficiency of rotary flash evaporator
3. Solving problems on single and multiple effect evaporator
4. Determination of separation efficiency of centrifugal separator.
5. Determination of collection efficiency in cyclone separator.
6. Determination of efficiency of liquid solid separation by filtration.
7. Determination of absorption efficiency in a packing tower
8. Determination of particle size of granular foods by sieve analysis.
9. Determination of performance characteristics in size reduction using the burr mill.
10. Determination of energy requirement in size reduction using the ball mill and hammer mill.
11. Performance evaluation of pin mill and hammer mill.
12. Performance evaluation of a steam distillation process.

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