



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Engineering

Level: Diploma

Branch: Chemical Engineering

Course / Subject Code: DI03005061

Course / Subject Name: Process Calculation

w. e. f. Academic Year:	2024-25
Semester:	3 rd
Category of the Course:	PCC

Prerequisite:	Fundamentals of Basic Chemical Engineering Calculations, Unit operations, Unit processes
Rationale:	Process calculation provides the fundamental information to determine the material and energy balances for all types of unit operations and unit processes across the equipment and overall chemical plant. Material and energy balance calculations are of prime importance for design and also for conservation of mass and energy to reduce the losses and cost that enhances overall economy of plant. The unit conversions, material and energy balance are the essential part in the practice of other courses such as mechanical operations, fluid flow, heat Transfer, mass transfer etc. Thus, this course is a core course for chemical engineers and should be learned sincerely by students

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	Calculate material balance for chemical processes and operations.	R, U, A
02	Understand Recycle, Bypass & Purging operation	R, U
03	Calculate energy balance for chemical processes and operations.	R, U, A
04	Estimate amount of fuel and amount of air required for combustion process.	R, U, A

**Revised Bloom's Taxonomy (RBT)*

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
L	T	PR	C	Theory		Tutorial / Practical		
				ESE (E)	PA(M)	PA(I)	ESE (V)	
3	0	0	3	70	30	00	00	100



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Course Content:

Unit No.	Content	No. of Hours	% of Weightage
Unit-1 Material Balance Without Chemical Reaction	1.1 Introduction of Material Balance 1.2 Numericals for Material balance calculation of 1.2.1 Distillation 1.2.2 Absorption 1.2.3 Drying 1.2.4 Extraction 1.2.5 Leaching 1.2.6 Evaporation 1.2.7 Mixing 1.2.8 Crystallization	12	27
Unit-2 Material Balance with Chemical Reactions	2.1 Define: Limiting reactant, Excess reactant, conversion, yield and selectivity 2.2 Numericals based on chemical reaction for finding yield, conversion, selectivity and composition.	08	17
Unit-3 Concept of Recycle and Bypass	3.1 Define: Recycle operation, Purging operation, Bypass operation 3.2 Description with Block diagram: Recycle operation, Purging operation, Bypass operation 3.3 Basics of: Recycle Ratio, Combined feed ratio, Purge ratio	03	7
Unit-4 Energy Balance	4.1 Introduction of energy balance 4.2 Heat capacity 4.2.1 Explain Heat capacity 4.2.2 Derive relation between C_p and C_v for an ideal gas. 4.2.3 Explain Heat Capacity of gases at constant pressure 4.2.4 Explain Heat Capacity of gaseous mixture. 4.3 Explain sensible and latent heat of fusion, sublimation, vaporization 4.3.1 Derive Equation for Sensible heat changes in gases at constant pressure 4.4 Numericals based on heat capacity and Sensible	12	27



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	heat changes 4.5 Enthalpy change associated with chemical reaction 4.5.1 Exothermic & Endothermic reaction 4.5.2 Standard Heat of reaction, Standard heat of formation, Standard heat of combustion 4.5.3 Calculations for heat of reaction from heat of formation and heat of combustion data 4.5.4 Hess's Law 4.5.5 Numericals based on Hess's Law		
Unit-5 Combustion	5.1 Introduction of combustion 5.2 Types of fuels 5.3 Describe Proximate and ultimate analysis of solid fuel 5.4 Explain Calorific values of fuels 5.4.1 Numericals related to calorific values of fuel 5.5 Air Requirement: Theoretical oxygen, Theoretical Air, Excess Air 5.5.1 Numericals related to air Requirement and composition of flue gases	10	22
	Total	45	100

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	U Level	A Level	N Level	E Level	C Level
18	30	52	-	-	-

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)



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References/Suggested Learning Resources:

(a) Books:

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Stoichiometry and Process Calculations	K.V. Narayanan, B. Lakshmikutty	Prentice-Hall of India Pvt. Ltd., 2006.
2	Stoichiometry	B I Bhatt and S B Thakore	McGraw Hill Education; 5th edition (1 July 2017)
3	Introduction to Process Calculations Stoichiometry	K. A. Gavhane	NiraliPrakasan, Pune, 2015
4	Basic Principles & Calculations in Chemical Engineering	David M. Himmelblau, James B. Riggs	PHI Learning Pvt. Ltd, 7th edition, 2006.
5	Industrial Stoichiometry: Chemical Calculations of Manufacturing Processes	H.C.Lewis, W.K.Lewis, A.H.Radasch,	McGraw-Hill, 2nd edition, 1954.
6	Process Calculations	Shekhar pandharipande Samir Mushrif	Pune Vidyarthi Griha Prakashan, Pune 411030

(b) Open-source software and website:

1 <https://nptel.ac.in/courses/103105209>

2 <https://nptel.ac.in/courses/103105110>

3 <https://www.unitoperation.com/>

4 <https://nptel.ac.in/courses/103103165>

Suggested Activities for Students:

A suggestive list of activities is given here. This has to match the competency and the COs. Similar projects could be added by the concerned course teacher:

1 Use of MS-Excel for solving numerical.

2 Calculate material balance of any process/operation/for a chemical plant for given data.

3 Calculate energy balance of any process/operation/for a chemical plant for given data.

4 Calculate air requirement for different fuel & composition of flue gases.

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