



Department of Chemical Engineering	LP: CH22301
B.E/B.Tech/M.E/M.Tech : B.Tech., Chemical Engineering Regulation: R 2022	Rev. No: 00
PG Specialisation : NA	Date:31.07.2023
Sub. Code/Sub.Name : CH22301 CHEMICAL PROCESS CALCULATIONS	
Unit : UNITS AND DIMENSIONS	

Unit Syllabus: Base and derived Units - Conversion of units and conversion factor Dimensional consistency, Composition of Mixture and solutions - calculations of pressure, volume and temperature using ideal gas law. Use of partial pressure and pure component volume in gas calculations, applications of real gas relationship in gas calculation

Objective: To impart knowledge on the basic fundamentals of process calculations.

Session No *	Topics to be covered	Ref	Teaching Aids
1	Introduction - Base and derived Units	T3 [Pg 1- 8,10-15] T2[P 8-13] R2[Pg 1-4]	Blackboard, PPT
2	Conversion of units and conversion factor Dimensional consistency – Problems	R3 [Pg 10-15] T2[P 8-13]	Blackboard, PPT
3	Composition of Mixture and solutions	R2[Pg 10-11] T3[Pg 47]	Blackboard, PPT
4	Problems on weight and mole basis	R2[Pg 10-11]	Blackboard, PPT
5	Calculations of pressure, volume and temperature using ideal gas law	T1[Pg 262-263] R2[Pg 35]	Blackboard, PPT
6	Problems using Ideal gas law	T1[Pg 262-263]	Blackboard, PPT
7	Use of partial pressure and pure component volume in gas calculations	R2[Pg 36-37]	Blackboard, PPT
8	Applications of real gas relationship in gas calculation	T1[Pg 279-305]	Blackboard, PPT
9	Revision		Blackboard, PPT

Content beyond syllabus covered (if any): Applications of Basic governing laws for Gas liquid systems

* Session duration: 50 minutes

**Sub. Code / Sub. Name:** CH22301 CHEMICAL PROCESS CALCULATIONS**Unit :** MATERIAL BALANCE WITH AND WITHOUT CHEMICAL REACTIONS

Unit Syllabus : Stoichiometric principles, Application of material balance to unit operations like distillation, evaporation, crystallisation, drying etc., multicomponent species analysis and Degree-of-Freedom Analysis Material balance with chemical reaction - Limiting and excess reactants - recycle - bypass and purging - Unsteady state material balances.

Objective: To enable the students to perform material balances on various unit operations and processes.

Session No *	Topics to be covered	Ref	Teaching Aids
10	Introduction to Material Balances	T1 [Pg 142 – 150] T2 [Pg 112 – 113] T3 [Pg 83 -89]	Blackboard, PPT
11	Material Balance Problems for Acid Mixing	T1[Pg 167 – 168]	Blackboard, PPT
12	Material Balance Problems for Single Units – Distillation, Evaporation	T1 [Pg 166 – 168] T2 [Pg 318 -320]	Blackboard, PPT
13	Material Balance Problems for Single Units – Crystallization & Drying	T1 [Pg 169 – 173] T2 [Pg 333 -339] T2 [Pg 360 -363]	Blackboard, PPT
14	Multicomponent species analysis and Degree-of-Freedom Analysis		Blackboard, PPT
15	Material balances for process involving reactions. Identification of limiting and excess reactants.	T3 [Pg 116- 119] R1 [Pg 199- 205]	Blackboard, PPT
16	Material balances for process involving recycle	T1 [Pg 206 -218] T3 [Pg 135 – 136] R2 [Pg 180 – 181]	Blackboard, PPT
17	Material balances for process involving bypass and purge, PROBLEMS	R2 [Pg 180 – 181] T1 [Pg 218 -225]	Blackboard, PPT
18	Unsteady state material balance	T1 [Pg 604 – 620] R2 [Pg 221 -228]	Blackboard, PPT

Content beyond syllabus covered (if any):

* Session duration: 50 mins



Sub. Code / Sub. Name: CH22301 CHEMICAL PROCESS CALCULATIONS

Unit : HUMIDITY AND SATURATION

Unit Syllabus : Basic of humidity and application of psychrometric chart - Use of humidity in condensation and drying – application of air-water system - cooling tower, types and basic calculation.

Objective: To enable the students to understand the concepts and calculations associated with humidification

Session No *	Topics to be covered	Ref	Teaching Aids
19	Introduction to humidification	T1 [Pg 487 – 501] R1 [Pg 110-127]	Blackboard, PPT
20	Introduction to Psychrometry and Psychrometric chart	T1 [Pg 487 – 501] R1 [Pg 110-127]	Blackboard, PPT
21	Basic properties of air – water system :	T1 [Pg 487 – 501] R1 [Pg 110-127]	Blackboard, PPT
22	Calculation of relative humidity and percentage humidity	T1 [Pg 487 – 501] R1 [Pg 110-127]	Blackboard, PPT
23	Humidity in condensation, drying and drying characteristics	T1 [Pg 487 – 501] R1 [Pg 110-127]	Blackboard, PPT
24	Dew point calculation from humidity chart	T1 [Pg 487 – 501] R1 [Pg 110-127]	Blackboard, PPT
25	Application of air water system – cooling tower	T1 [Pg 487 – 501]	Blackboard, PPT
26	Types and basic calculations in cooling towers	T1 [Pg 487 – 501] R2 [Pg 90-106]	Blackboard, PPT
27	Revision		Blackboard, PPT

Content beyond syllabus covered (if any):

* Session duration: 50 mins



Sub. Code / Sub. Name: CH22301 CHEMICAL PROCESS CALCULATIONS

Unit : ENERGY BALANCE WITH AND WITHOUT CHEMICAL REACTIONS

Unit Syllabus : Heat capacity of solids, liquids, gases and solutions, use of mean heat capacity in heat calculations, problems involving sensible heat and latent heats, evaluation of enthalpy. Standard heat of reaction, heats of formation, combustion, solution, mixing etc., calculation of standard heat of reaction - Effect of pressure and temperature on heat of reaction -Energy balance for systems with and without chemical reaction - Unsteady state energy balances

Objective: To enable the students to perform energy balance calculations on various unit operations and processes.

Session No *	Topics to be covered	Ref	Teaching Aids
28.	Introduction to Energy Balance, Conservation of Energy processes	T1 [Pg388 – 424] T3 [Pg 313-329]	Blackboard, PPT
29.	Heat capacity and mean heat capacity	T2 [Pg 181 -204]	Blackboard, PPT
30.	Energy balance problems without reaction-Sensible heat	T2 [Pg 194-201]	Blackboard, PPT
31.	Energy balance problems without reaction – Latent heat	T2 [Pg205 - 222]	Blackboard, PPT
32.	Effect of pressure and temperature on heat of reaction	T3 [Pg 442-443]	Blackboard, PPT
33.	Standard heat of reaction, heat of formation, combustion, solution, mixing etc.,	R2 [Pg 196-197]	Blackboard, PPT
34.	Energy balance problems with Reactions	R2 [Pg 197-217]	Blackboard, PPT
35.	Energy balance problems with Reactions	R2 [Pg 197-217]	Blackboard, PPT
36.	Unsteady state energy balance	T1 [Pg617 – 621]	Blackboard, PPT

Content beyond syllabus covered (if any):

* Session duration: 50 mins



Sub. Code / Sub. Name: CH22301 CHEMICAL PROCESS CALCULATIONS

Unit : FLUE GAS ANALYSIS

Unit Syllabus : Determination of Composition by Orsat analysis of products of combustion of solid, liquid and gas fuels - Calculation of excess air from Orsat technique, Combustion processes –Flue gas analysis, Ultimate and Proximate analyses of coal. Application of Process simulators and excel solver tool in energy and material balance problems.

Objective: To enable the students to understand the concepts and calculations associated with gases and other combustion operations in industry.

Session No *	Topics to be covered	Ref	Teaching Aids
37.	Introduction to Combustion	T1 [Pg176-178] T2 [Pg 389]	Blackboard, PPT
38.	Orsat analysis of solid, liquid and gas fuels	T2 [Pg 427-448] R2 [Pg129]	Blackboard, PPT
39.	Orsat analysis of solid, liquid and gas fuels	T2 [Pg 427-448] R2 [Pg129]	Blackboard, PPT
40.	Calculation of excess air from Orsat Technique	T3 [Pg144-145]	Blackboard, PPT
41.	Flue gas analysis	T2 [Pg407-427]	Blackboard, PPT
42.	Flue gas analysis	T2 [Pg407-427]	Blackboard, PPT
43.	Proximate analysis and Ultimate analysis	T2 [Pg391-395]	Blackboard, PPT
44.	Application of process simulators in material and energy balance problems	T2 [Pg 540-583] Aspen Plus	Blackboard, PPT, Computational Facility
45.	Application of excel solver tool in material and energy balance problems	T2 [Pg 540-583] Microsoft excel	Blackboard, PPT, Computational Facility
Content beyond syllabus covered (if any):			

* Session duration: 50 mins

**Sub Code / Sub Name:** CH22301 CHEMICAL PROCESS CALCULATIONS**TEXTBOOKS:**

1. David M. Himmelblau, "Basic Principles and Calculations in Chemical Engineering", Eighth Edition, Prentice Hall of India, New Delhi, 2012
2. Bhatt B.I. and Vora S.M., "Stoichiometry", Second Edition, Tata McGraw Hill, New Delhi, 2004
3. Felder, R. M. and Rousseau, R. W., "Elementary Principles of Chemical Processes", Third Edition, John Wiley & Sons, New York, 2005

REFERENCES:

1. Hougén O A, Watson K M and Ragatz R A, "Chemical process principles" Part I, Second Edition, CBS publishers, 1976.
2. Venkatramani. V, Anatharaman. N and Meera Shariffa Begam "Process Calculations" Prentice Hall of India, New Delhi.

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Date	31.07.2023	31.07.2023
Remarks *:		
Remarks *:		
* If the same lesson plan is followed in the subsequent semester/year it should be mentioned and signed by the Faculty and the HOD		
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