



Department of Chemical Engineering		LP: CH 22304 Rev. No: 0
B.E/B.Tech/M.E/M.Tech : <u>Chemical Engineering</u>	Regulation: 2022	Date: 31.07.2023
PG Specialisation : Not Applicable		
Sub. Code / Sub. Name : CH 22304 MECHANICAL OPERATIONS		
Unit : I		

Unit Syllabus: Particle shape and size, different ways of expression of particle size, shape factor, sphericity. Mixed particle size analysis, standard screens, Differential and cumulative size analysis, specific surface of mixture of particles, number of particles in a mixture. Screens, ideal and Actual screens, Effectiveness of screen, Standard Screen Series, sub sieve analysis – air permeability method.

Objective: To understand particle characteristics and size analysis

Session No *	Topics to be covered	Ref	Teaching Aids
1.	Particle shape and size, different ways of expression of particle size	T1 (Pg. 967)	PPT & BB
2.	Shape factor, sphericity. Mixed particle size analysis,	T1 (Pg. 967 - 969)	PPT & BB
3.	Differential and cumulative analysis	T1(Pg. 969)	PPT & BB
4.	Specific surface of mixture of particles, Number of particles in a mixture determination	T1 (Pg. 969 – 971)	PPT & BB
5.	Standard Screens, ideal and Actual screens; Industrial screening Equipment	T1 (Pg. 1001 - 1003)	PPT & BB
6.	Screening –Separation without involvement of fluid mechanics	T2 (Pg. 618 - 627)	PPT & BB
7.	Ideal and actual screens, Screen Effectiveness	T1 (Pg. 1003 - 1005)	PPT & BB
8.	Tutorial	T1 (Pg.973)	PPT & BB
9.	Sub sieve analysis – air permeability method.	T1&T2 (Pg. 994 - 1000)	PPT & BB
Content beyond syllabus covered (if any): Overview of particle count and size measurement using Coulte counter			

* Session duration: 50 minutes



Sub. Code / Sub. Name: **CH 22304 MECHANICAL OPERATIONS**

Unit : II

Unit Syllabus : Introduction – types of forces used for comminution, Criteria for comminution, Characteristics of comminuted products, Laws of size reduction, Work Index, Energy utilization, methods of operating crushers – Free and choke feeding, open circuit grinding, Closed circuit grinding, wet and dry grinding, Equipment's for size reduction & its operation– Jaw crusher, Roll crusher, Hammer mill, Ball mill, Fluid energy mill. Principles and importance of Size enlargement.

Objective: To understand particle size reduction, its equipment, Power calculation and Principle of Size enlargement.

Session No *	Topics to be covered	Ref	Teaching Aids
10.	Introduction – types of forces used for comminution, Criteria for comminution,	T1 (Pg. 984 - 986)	PPT & BB
11.	Characteristics of comminuted products, Laws of size reduction	T1 (Pg. 984 - 986)	PPT & BB
12.	Work Index, Energy utilization,	T1 (Pg. 984 - 986)	PPT & BB
13.	Tutorial	T1 (Pg. 986)	PPT & BB
14.	Methods of operating crushers – Free and choke feeding, open circuit grinding, Closed circuit grinding, wet and	T2 (Pg. 684 - 685)	PPT & BB
15.	Tutorial	T1 (Pg. 999)	PPT & BB
16.	Equipment's for size reduction & its operation– Jaw crusher, Roll crusher.	T1 (Pg.988 – 989) T2 (Pg. 661 - 678)	PPT & BB
17.	Equipment's for size reduction & its operation–Hammer mill, Ball mill, Fluid energy mill.	T1 (Pg.989 – 994) T2 (Pg. 661 - 678)	PPT & BB
18.	Principles and importance of Size enlargement.	T1 (Pg. 997)	PPT & BB

Content beyond syllabus covered (if any): Mitigation plans for dust collection during size reduction operation

* Session duration: 50 mins



Sub. Code / Sub. Name: **CH 22304 MECHANICAL OPERATIONS**

Unit : III

Unit Syllabus: Mechanics of particle motion, Equation for one dimensional motion of particles through a fluid in gravitational and centrifugal field, Terminal velocity, drag coefficient, Motion of spherical particles in Stoke's region, Newton's region, and Intermediate region, Criterion for settling regime, Hindered settling, Modification of equation for hindered settling. Equipment's for particle separation and its operation – Gravity settling, double cone classifier, rake classifier and surface area estimation for thickener. Centrifugal separation principle - cyclones and hydro cyclones.

Objective: To understand solid liquid separation in industrial equipment based on settling, density and centrifugal force.

Session No *	Topics to be covered	Ref	Teaching Aids
19.	Mechanics of particle motion, Equation for one dimensional motion of particles through a fluid in gravitational and centrifugal field.	T1 (Pg. 167 – 169) T2 (Pg. 637 – 643)	PPT & BB
20.	Tutorial: Terminal velocity, drag coefficient.	T1 (Pg.169 – 171) T2 (Pg. 642 - 643)	PPT & BB
21.	Motion of spherical particles in Stoke's region, Newton's region, and Intermediate region,	T1 (Pg.171 – 174)	PPT & BB
22.	Criterion for settling regime,	T1 (Pg.172 – 174)	PPT & BB
23.	Hindered settling, Modification of equation for hindered settling.	T2 (Pg. 647 - 1072)	PPT & BB
24.	Equipment's for particle separation and its operation – Gravity settling.	T2 (Pg. 632 – 636)	PPT & BB
25.	Equipment's for particle separation and its operation – double cone classifier, rake classifier.	T2 (Pg. 632 – 636)	PPT & BB
26.	Equipment's for particle separation and its operation – surface area estimation for thickener.	T2 (Pg. 649 – 657)	PPT & BB
27.	Tutorial	T1 (Pg. 1079 – 1083)	PPT & BB
28.	Cyclones and hydro cyclones	T1(Pg. 1066 - 1069)	PPT & BB

Content beyond syllabus covered (if any): Utilization of Froth Floatation in separation equipment.



* Session duration: 50 mins

Sub. Code / Sub. Name: **CH 22304 MECHANICAL OPERATIONS**

Unit : IV

Unit Syllabus : Theory of filtration, Batch and continuous filters, Flow through filter cake and filter media, compressible and incompressible filter cakes, filter aids. Filtration equipment's - selection, operation and optimum cycle of operation, Principle of operation – plate and frame filter press, leaf filter, bag filter, electrostatic precipitator.

Objective : To understand filtration theory its equipment, operation and parameters calculations.

Session No *	Topics to be covered	Ref	Teaching Aids
29.	Theory of filtration, Batch and continuous filters.	T1 (Pg. 1002 – 1016)	PPT & BB
30.	Flow through filter cake and filter media, incompressible filter cakes	T1 (Pg. 1019 - 1024)	PPT & BB
31.	Flow through filter cake and filter media, compressible filter cakes,	T1 (Pg. 1019 - 1024)	PPT & BB
32.	Filter aids. Filtration equipment's - selection,	T1 (Pg. 1006 - 1018)	PPT & BB
33.	Tutorial	T1(Pg.1024, 1066 - 1069) T2 (Pg. 580 – 592)	PPT & BB
34.	Filtration equipment's - operation and optimum cycle of operation,	T1 (Pg. 1015 – 1019) T2 (Pg. 590 – 592)	PPT & BB
35.	Principle of operation – plate and frame filter press, leaf filter.	T2 (Pg. 627 - 632)	PPT & BB
36.	Principle of operation – bag filter, electrostatic precipitator.	T2 (Pg. 627 - 632)	PPT & BB
37.	Tutorial	T2 (Pg. 580 – 592)	PPT & BB

Content beyond syllabus covered (if any): Centrifuges and importance in filtration

* Session duration: 50 mins



Sub. Code / Sub. Name: **CH 22304 MECHANICAL OPERATIONS**

Unit : V

Unit Syllabus : Mixing and agitation - Mixing of liquids (with or without solids), mixing of powders, selection of suitable mixers, power requirement for mixing. Storage of solids - Bunkers, silos, bins, and hoppers. Principles in transportation of solids in bulk – Conveying – belt, bucket and pneumatic.

Objective: To understand Mixing, Agitation, Storage of solids and various types of conveying of solids

Session No *	Topics to be covered	Ref	Teaching Aids
38	Mixing and agitation, power requirement for mixing	T1 (Pg. 234 – 262) (Pg. 977,985)	PPT & BB
39	Tutorial	T1 (Pg. 263,289)	PPT & BB
40	Liquid Mixing (with or without solids),	T1 (Pg. 265 – 276) (Pg. 978 - 986)	PPT & BB
41	Powder Mixing, Suitable mixer selection for an operation.	T1 & T2 (Pg. 978 – 986) (Pg. 609 - 612)	PPT & BB
42	Storage of solids Bunkers, Silos.	T1 (Pg. 974 – 977)	PPT & BB
43	Storage of solids Bins and hoppers	T1 (Pg. 974 – 977)	PPT & BB
44	Transportation of solids in bulk, belt & bucket conveyer	T1&T2 (Pg. 977) (Pg. 687 – 706)	PPT & BB
45	Principles involved in Pneumatic Conveying	T1&T2 (Pg. 187 – 188) (Pg. 702 – 714)	PPT & BB

Content beyond syllabus covered (if any): Mixing and Agitation of heat sensitive material

* Session duration: 50 mins



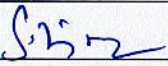
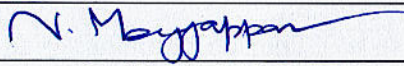
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TEXT BOOKS:

1. McCabe, W.L., Smith, J.C., and Harriot, P., "Unit Operations in Chemical Engineering", 7th Edn., McGraw-Hill, 2005.
2. Badger W.L. and Banchero J.T., "Introduction to Chemical Engineering", Tata McGraw Hill, 1997.
3. Foust, A. S., Wenzel, L.A., Clump, C.W., Naus, L., and Anderson, L.B., "Principles of Unit Operations", 2nd Edn., John Wiley & Sons, 1994.
4. Coulson, J.M. and Richardson, J.F., "Chemical Engineering" Vol. II, 4th Edn., Asian Books Pvt. Ltd., India, 1998.

REFERENCES:

1. Hiroaki Masuda , KoHigashitani and Hideto Yoshida, Powder Technology Handbook, 4th Edition. Taylor & Francis, 2006
2. Christie J. Geankoplis, Transport processes and unit operations, Prentice Hall, 2018.
3. Sunggyu Lee, Kimberly H. Henthorn, Particle Technology and Applications, CRC Press, 2017.
4. Martin Rhodes, Introduction to Particle Technology, Second Edition, John Wiley & Sons, 2008.
5. Unit Operations-I, Fluid Flow & Mechanical Operation, K.A Gavhane, Nirali Prakashan, 2016.

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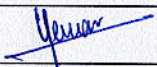
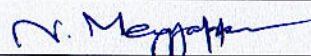
* If the same lesson plan is followed in the subsequent semester/year it should be mentioned and signed by the Faculty and the HOD



SRI VENKATESWARA COLLEGE OF ENGINEERING

COURSE DELIVERY PLAN - THEORY

Sub Code / Sub Name: **CH 22304 MECHANICAL OPERATIONS**

	Prepared by	Approved by
Signature		
Name	Dr.G.MANIKANDAN	Dr N. MEYYAPPAN
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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

Verified
5/7/24