



**Program:** B.Sc.

**Academic Year:**

**Semester:**

**CHE 0915351: Unit operations of Particulate solids  
 Course Catalog (2019)**

Characterization of solids: solid properties, size analysis, solids in bulk, handling and flow of solids, size reduction. Fluid particle systems: packing and packed columns, sedimentation, filtration, centrifugation, mixing, flotation and fluidization.

<b>Credit hours</b>	3	level	3	<b>Pre-requisite(s)</b>	<b>0905241</b>
Instructor Prof. Yahya Khraisha	<b>Office number</b> <b>CHE000</b>			<b>Office phone</b> Ext. 22881	
<b>Course website</b> <a href="https://elearning.ju.edu.jo/login/index.php">https://elearning.ju.edu.jo/login/index.php</a> Live Streaming Platform: Microsoft Teams		<b>E-mail</b> <b>khraisha@ju.edu.jo</b>		<b>Place</b> Refer to Registration website	

**Textbooks:**

- Coulson and Richardson's Chemical Engineering, 6th ed., Vol. 2A: Particulate Systems and Particle Technology, Editors: R. P. Chhabra Basavaraj Gurappa, Butterworth-Heinemann, 2019.
- J.M.Coulson and J.F.Richardson, "Chemical Engineering", Vol.2, 4th ed., Pergamon Press, 2002.
- Handouts

**References:**

- Martin Rhodes, "Introduction to Particle Technology", 2nd ed., John Wiley & Son Ltd., 2008.
- R.H.Perry and C.H. Chilton, "Chemical Engineers Handbook", McGraw- Hill, 1987.
- Coulson, J. M. & Richardson, J. F., Chemical engineering, vol. 6, Pergamon Press, Oxford, 2003.
- W.L.McCabe, J.C.Smith and P.Harriot, "Unit Operations of Chemical Engineering", McGraw- Hill, Fifth Edition, 1993.

**Learning Objectives and Intended Learning Outcomes**

<b>Objectives</b>	<b>Outcomes</b>
1. Basic understanding of operations of solid particulates and its importance to chemical engineering applications.	<b>1.1</b> Gain knowledge to identify the characteristics of an individual particle (particle shape, sphericity, solid and bulk density, particle size). <b>O1</b>

	<p>1.2 Realizing the important operations relating to systems of particles, such as storage in hoppers and mixing two or more solids.</p> <p>1.3 Understand the science of particles in bulk behavior and unit operations processes. <b>O1</b></p>
<p>2. Developing a fundamental understanding of the basic principles of solid particulates</p>	<p>2.1 Demonstrate ability to identify the important physical mechanisms occurring in processes involving particles. <b>O1</b></p> <p>2.2 Demonstrate ability to characterize the particle size distribution in the mixture and to define a mean size. <b>O1, O2</b></p>
<p>3. Realizing the important operations relating to systems of particles, such as storage in hoppers and mixing two or more solids.</p>	<p>3.1 Understand the science of particles in bulk behavior and unit operations processes. <b>O1</b></p>
<p>4. Particle mechanics analysis for spherical and non-spherical particles.</p>	<p>4.1 Understand the analysis of forces on spherical and non-spherical particles moving in gravitational and centrifugal fields. <b>O1</b></p> <p>4.2 Finding the terminal falling velocities for different regimes (Stokes', transition and form drag regimes). <b>O1</b></p>
<p>5. Fundamental understanding of the particles preparation, separation and motion.</p>	<p>5.1 Demonstrate ability to describe and analyze the processes of crushing, grinding, classification, flotation, thickening and particles transport. <b>O1, O2</b></p> <p>5.2 Know the interaction between the particles and the surrounding fluid. <b>O1</b></p>
<p>6. Designing of unit operations involving solid particulate materials.</p>	<p>6.1 Apply knowledge from general science and engineering courses to design and solve problems in unit operations related to solid particulates in different application <b>O1</b></p> <p>6.2 Realize the concept of flow of fluids through granular beds and packed columns, and particles fluidization <b>O1, O2</b></p>
<p>7. Enhance the ability of students for life-long learning and communication skills.</p>	<p>7.1 Enhance students' skills through intensive use of available data resources and short projects with written and oral presentations. <b>O7</b></p>

## Topics Covered

Week	Topic	Ref.
1	Introduction & Syllabus	Handouts, Textbook
2-3	Characterization of single particle	Handouts, Textbook
4	Solid particulates in bulk	Handouts, Textbook
5	Mixing and blending of solid particles	Handouts, Textbook
6	Solid particles separation	Handouts, Textbook
7-8	Size reduction	Handouts, Textbook
9-10	Motion of particles in gravitational and centrifugal fluids	Handouts, Textbook
11-12	Flow through granular/fixe bed (Packed column)	Handouts, Textbook
13-14	Sedimentation	Handouts, Textbook
15	Fluidization	Handouts, Textbook
16	Filtration	Handouts, Textbook

## Evaluation

Evaluation tools	Weight	Dates
Midterm Exam	30	Will be announced by the department
Project	10	Will be arranged between the 5 <sup>th</sup> and 16 <sup>th</sup> weeks
Quizzes and activities	10	-
Final Exam	50	Will be announced by the University

## Relationship to Program Outcomes

O1	O2	O3	O4	O5	O6	O7				
X	X					X				

## Relationship to CHE Program Objectives

PEO1	PEO2	PEO3	PEO4	PEO5	PEO6	PEO7	PEO8	PEO9	PEO10	PEO11
√	√	√		√						

## Document Control

Prepared by	Prof. Yahya Khraisha
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