Department of Chemical Engineering
College of Engineering
University of the Philippines
Diliman, Quezon City

ChE 134

Momentum Transfer & Materials Handling Equipment Design

Course Description: Applications of the principles of momentum transfer to process equipment design; The energy balance in flow systems; Materials handling.

Course Prerequisites: ChE 131

Course Credit: 3.0 units (2 h lecture, 3 h laboratory)

Program Educational Objectives (BS Chemical Engineering)
The program aims to educate students such that three to five years from graduation, they:

1. take leadership roles in their respective fields and/or effectively work in or manage a team;
2. are equipped with the extensive knowledge and relevant skills necessary to succeed in their chosen careers and to become responsive citizens;
3. are able to demonstrate strong research & innovative capability as they recognize and address opportunities and challenges in their respective spheres of influence;
4. have shown strong commitment to the ethical practice of their profession; to health, safety and environment; and service to society.

Course Outcomes
At the end of the course, the student should be able to:

1. Apply material and energy balance calculations to steady-state and unsteady-state flow systems, multiple phase separation processes, and material transport and storage.
2. Demonstrate a good grasp of fluid mechanics and design or analyze solid-fluid/gas-liquid separation systems based on fluid mechanics (e.g. classification equipment, sedimentation equipment, filters) and other operations involving particulate solids (fluidized beds, solid-fluid conveying).
3. Design a piping system, select and size simple agitation equipment to meet process objectives, select and size pumps, blowers and compressors, specify design and operating parameters for separation process and materials handling and transport equipment.
4. Write/Present a summary report of the design procedure carried out in class.

Student Outcomes Satisfied by Course Outcomes

[a] Ability to apply knowledge of mathematics and science to solve engineering problems

[c] Ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability, in accordance with standards

[g] Ability to communicate effectively

Course Content

Meeting	Topic	Objective
1-2	Introduction, expectation and student survey. Review of fundamental concepts	Introduce the course and set expectations for the class. Review pertinent and foundational concepts.
3 (L) 4 (CL)	General energy balance Mechanical energy balance for incompressible flow	Apply energy balance to flow systems.

Meeting	Topic	Objective
5 (L) 6 (CL)	Pipes and tubings Fittings and valves Evaluation of fluid friction	Identify sources of friction losses. Evaluate friction losses.
7 (L) 8 (CL)	Parallel piping systems (incompressible flow) Fluid Metering	Solve problems involving parallel piping systems. Apply energy balance to fluid metering and size fluid metering devices.
First Long Examination		
9 (L) 10 (CL)	Agitation and Mixing of Fluids: Theory and Calculation	Select and size simple agitation equipment to meet process objectives.
11(L) 12 (CL)	Transportation of Liquids (pumps)	Learn the theory on proper selection and sizing of pumps.
13 (L) 14 (CL)	Compressible Flow Transportation of Gases (Fans, blowers and compressors)	Apply energy balance equation to compressible flow and know various equipment for transporting gases.
Second Long Examination		
15 (L) 16 (CL)	Properties and Handling of Solids (Particle characterization and screening)	Understand the methods for characterizing solid particles. Interpret screening analyses and determine screening effectiveness.
17 (L) 18 (CL)	Size Reduction Size enlargement	Know various size reduction equipment and size enlargement methods. Calculate the efficiency of the size reduction process.
19 (L) 20 (CL)	Transport and Storage of Solids	Know various equipment for transporting, conveying and storing solids. Specify power requirements and minimum design parameters.
Third Long Examination		
21 (L) 22 (CL)	Particle Dynamics Classification	Understand particle dynamics and apply the principles for classifying solids.
23 (L) 24 (CL)	Fluidization	Learn the principles of fluidization and specify the design parameters for fluidized beds
25 (L) 26 (CL)	Sedimentation	Learn the principles of sedimentation and calculate for the area needed for thickeners.
27 (L) 28 (CL)	Centrifugation Gas-Solid Separation (cyclones)	Analyze and design separation processes utilizing centrifugal force.
29 (L) 30 (CL) 31 (L) 32 (CL)	Filtration	Learn filtration theory and solve for the filter area and filtration time.
Fourth Long Examination		
Presentation of Design Project		

Course Assessment

Long Examinations (4)	50%
Classwork	20%
Design Project	20%
Reporting	10%

Course Policies

1. **Attendance**
   Attendance shall be checked by the instructor every meeting. A student may incur a maximum of three (3) absences for the lecture part and six (6) absences for the lab part. A student incurring absences beyond the maximum in any of the two parts will be given a grade of 5.0 unless s/he drops from the class.
2. **Exams**
   a. Exams are closed-book. Necessary tables and figures will be provided.
   b. Sit-in exams shall consist of both objective and problem solving questions. Scoring shall be based on the validity of the final answer; however partial credit may be awarded accordingly based on the written solution for problem solving questions. Awarding of partial points is strictly under the discretion of the instructor. Sit-in exams shall be at most three (3) hours long.
   c. Grievances regarding checked exams shall be entertained only within two (2) meetings upon the return of papers or announcement of scores. All grievances (for any reason) will not affect the grades if they are raised after the 2-meeting grace period. Solutions with suspicious markings or erasures shall not be awarded with any points.
   d. A student who misses an exam must submit an official excuse slip from the administrative office to the instructor on or before the schedule of the next exam. Excuse slips submitted past the deadline will not be accepted. A student may miss only one long exam with a valid excuse; any other missed long exam, with or without valid excuse, shall be given a score of zero. Valid excuse includes sickness of the student and death in the family. Representation of the college, the university or the country in a duly-recognized competition will be considered a valid excuse provided the necessary documents are presented as proof.
3. **Design Project**
   Design projects will be done by group. Details will be given in a separate document.
4. **Class Works**
   a. The grades for the class works will come from quizzes, problem sets, laboratory exercises, home works and seat works.
   b. Lecture materials will be uploaded a week before the scheduled discussion. Students are expected to download these materials and study them before coming to class. Additional discussions will be carried out by the instructor during class to reinforce learning. IMPORTANT: Do not come to class if you have not read AND studied the lecture materials and assigned readings. The instructor will not tolerate passive learning during class.
   c. Quizzes are also available online to test the student's basic knowledge of the topic being discussed during the week. Students are required to complete the quiz, and may do so any time during the week. The active period for the quiz expires 11:59 PM during Sundays. Non-compliance will result to a score of zero for that quiz.
5. **Reporting**
   a. Groups will be assigned certain topic/s for reporting in class.
   b. A handout must be prepared by the assigned reporter. A softcopy of this handout must be emailed to the instructor on same day as the schedule of the presentation.
   c. Handouts must contain the following:
      Name of Equipment
      Diagram showing the parts of the equipment
      Photo of actual equipment
      Explanation of the parts of the equipment
      How the equipment works
      Applications/Uses
6. **General Guidelines**
   a. University rules on cheating, leave of absence, etc. apply.
   b. Courtesy towards each person in this class is expected. Thus, any behavior that will impede learning should be avoided. Refrain from sending messages and making calls through your cellular phones during class hours. Keep your cellular phones in mute or silent mode or turn it OFF while in class.
   c. Requirements not submitted on time will not be graded (i.e. will be given a grade of zero).
   d. The instructor reserves the right to amend class policies when deemed necessary.

Grading System

1.00	1.25	1.50	1.75	2.00	2.25	2.5	2.75	3.00	5.00
[92,100]	[88,92)	[84,88)	[80,84)	[76,80)	[72,76)	[68,72)	[64,68)	[60,64)	[0,60)

List of Instructors

Prof. Charlimagne Montealegre
Engr. Bemboy Niño Subosa
Engr. Michael Sean Deang
Engr. John Von Wernher dela Cruz

References

1. Darby, Ron. *Chemical Engineering Fluid Mechanics,* 2nd Ed.
2. Foust, Alan S. et.al., *Principles of Unit Operations*, 2nd Ed.
3. Cengel, Yunus A., and Cimbala, John M. *Fluid Mechanics: Fundamentals and Applications.*
4. Mott, Robert, *Applied Fluid Mechanics*, 5th Ed.
5. Brown, George G. et.al., *Unit Operations*, Modern Asia Edition.
6. McCabe, Warren L. et.al., *Unit Operations of Chemical Engineering*, 7th Ed.
7. Rhodes, Martin, et. al., Introduction to Particle Technology, 2nd Ed.
8. Richardson, J.F., Harker, J.H. , Backhurst, J.R. *Coulson and Richardson's Chemical Engineering: Particle Technology and Separation Processes,* Volume 2 5th Edition.
9. *Perry's Chemical Engineer's Handbook*, 7th Ed/8th Ed