

UNIVERSITY OF CALGARY
DEPARTMENT OF CHEMISTRY
COURSE SYLLABUS
WINTER 2021

COURSE: CHEMISTRY 579, Surface and Colloid Chemistry for Engineers

LEC	DAYS	TIME	ROOM	INSTRUCTOR	OFFICE	EMAIL	OFFICE HOURS
L01	TR	11:00-12:15 [11:00-2:00]	Online	Dr. Robert Marriott	SB 221	Rob.marriott@ucalgary.ca	TR 12:30 – 2:30

MATERIAL TO BE COVERED:

- (1) Introduction to colloids and surfaces
 - common colloidal systems
 - introduction and importance of common terms, e.g., specific surface area, particle dimensions
 - review of reaction coordinate diagrams
- (2) Solid-gas interfaces
 - Crystallite face indexing and surface defects
 - Basic gas adsorption and the common Langmuir isotherms
 - Empirical isotherms, IUPAC isotherm classification and isosteric heats of adsorption
 - Common industrial mesoporous solids for separation or heterogeneous catalysis
 - The BET isotherm and mesopore volume distribution
 - Exercise 3 – drying a high-pressure CO₂ stream (an example of adsorptive separation)
- (3) Kinetic and statistical forces – particle and continuous phase (minimal particle-particle forces)
 - External forces and drift (terminal) velocity
 - Sedimentation coefficients (measurement)
 - Viscous forces and Brownian motion
 - Air filtration (HEPA, N95, electrostatic, etc.)
 - Sedimentation equilibrium - a case study for aqueous pollutants
- (4) Particle-particle electrostatic forces
 - Particle-particle interactions
 - Inter-molecular forces related to inter-particulate forces
 - Hamaker theory
 - Electrical charges in dispersions
 - Guoy-Chapman and the Debye-Hückel approximation
 - Debye thickness and total surface charge
 - Double layer overlap
 - DVLO recap and the CCC scale
- (5) Colloidal stability
 - Stability ratio and overall flocculation rate
 - Steric effects
 - Surface tension
 - Sesile drop, wetting and spreading, porosimetry
 - Wetting irregular surfaces and the Jamin effect
 - Surface active solutes – miscible, immiscible and partially miscible
 - Emulsion stability – HLB scale, PITs and emulsifiers in froth floatation
 - Foams

TEXTBOOKS:

Although no textbook is required, reading will be assigned using on-line resources available to University of Calgary Students. The following additional texts may be useful to students:

- Principles of Colloid and Surface Chemistry*, 3rd. Ed., Paul C. Hiemenz and Raj Rajogopalan, CRC (1997)
Colloid Science: Principles, Methods and Applications, 3rd. Terence Cosgrove, Blackwell (2005) [online at the University of Calgary]
Contact Angle, Wettability and Adhesion, Vol. 4., Kash L. Mittal (2006) [Online at the University of Calgary]
Colloidal Dispersions: Suspensions, Emulsions and Foams, Ian D. Morrison and Sydney Ross, Wiley (2002)