PHYSICS/CHEM 207: Applied Physical Chemistry (http://www.chem.uci.edu/~ardo/applpchem.html)
Departments of Physics & Astronomy / Chemistry, UCI, Summer 2022 *Version Date: 2022.07.06*

Instructor Professor Shane Ardo (ardo@uci.edu); *Office Hours*: By appointment only *(via Zoom)*
Meetings *Class*: M–F @ 9 am – noon PDT (FRH 4135) *(video recordings may be available)*

Course Objectives

- To understand aspects of chemistry that are not often taught to, but are relevant to, physics students
- To instill thermodynamic and kinetic language that unites physics, chemistry, and engineering
- To quantitatively and qualitatively assess chemical systems, experimental data, and problems
- To summarize, explain, and critically evaluate seminal and recent chemistry peer-reviewed articles

Representative Topics Covered

Topic 1 **Chemical Properties** (Molecular nomenclature, Solutions, Balanced chemical reactions, State functions, Standard states, Thermochemistry, Non-ideal gases, Intermolecular forces, Physical properties, Phase changes, Colligative properties, Water activity, Free energy, (X)Chemical potential, Chemical equilibrium, van't Hoff equation, Activity coefficients, Le Chatelier's principle, Schrödinger equation, Atomic orbitals, Hybridization, Valence bond theory, Molecular orbital theory, Band diagrams, Crystal field theory, Ligand field theory)

Topic 2 **Charged Interfaces** (Redox half-reactions, Nernst equation, Electrodes, Potentiostat, Pourbaix diagram, Electric potential, Double layer, Membrane potential, Liquid-junction potential, Donnan potential, Acidity scale, pH probe)

Topic 3 **Chemical Kinetics** (Continuity of mass, Mass transfer, Nernst–Planck equation, Diffusion, Diffusion coefficient, Migration, Mobility, Convection, Boundary layer, Mass action, Microscopic reversibility, Förster cube, Square schemes, Activation energies, Marcus–Hush theory, Transition-state character, Reorganization energy, Linear free energy relationships, Superexchange, Outer/inner sphere, Butler–Volmer equation, Fermi's golden rule, Solid-state physics, Gerischer theory, Rate-determining step, Steady-state/Pre-equilibrium approximations, Langmuir/Frumklin isotherms)

Topic 4 **Photochemistry** (Blackbody radiation, Einstein coefficients, Born–Oppenheimer approximation, Harmonic oscillator model, Franck–Condon principle, Transition dipole moment operator, Beer–Lambert law, Absorption coefficient, Oscillator strength, Absorptance, Jablonski diagram, Internal conversion, Intersystem crossing, Thexi state, Kasha–Vavilov rule, Luminescence processes, Conservation laws, Selection rules, E–k diagrams, Energy transfer processes, Excited-state photochemical reactions, Photochemical length scales, Photochemical time scales, Electromagnetic spectrum, Steady-state spectroscopies, Pump–probe transient spectroscopies)

Grading

50% *Synchronous Assignments* (~10 of them *(your lowest score will be dropped)*; pre-lecture quizzes that will be worked on *individually* and then *in groups*, before being discussed)
20% *Synchronous Presentation* (*~15 min per student*; during penultimate class period (Th7/28))
30% *Synchronous Final Examination* (during the final class period (F7/29))

Course Policies

Late assignments are not accepted, and a make-up examination is not available.
UCI Add/Drop WebReg: https://www.reg.uci.edu/calendars/quarterly/2021-2022/quarterly21-22.html
UCI Chemistry Enrollment Inquiries: https://www.chem.uci.edu/studentaffairs/, or chemistry@uci.edu
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